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features in this issue...

Why Cows and Sheep Bloat

Bovine Hyperkeratosis from Pellet Feed

Free-Choice Phenothiazine for Control of Cattle Parasites

Buffalo Gnats and Leucocytozoon Infection of Poultry

Effect of Nitrogen Mustard on Hog Cholera Virus

Veterinary Medicine in Sweden

Suspension of Hexylresorcinol for Removing Intestinal Parasites of Dogs

Clinical Use of Kaopectate with Neomycin in Bacterial Gastroenteritis

(Complete Index on Page VIII)

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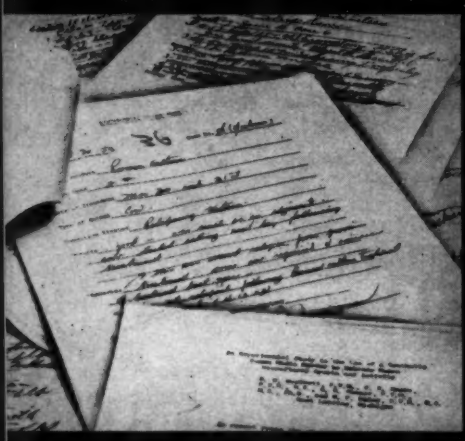

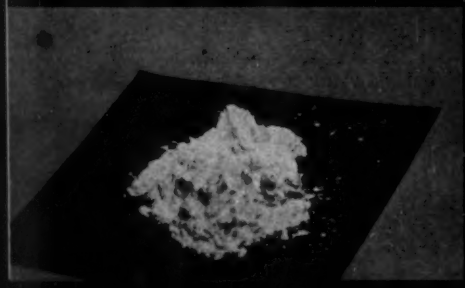

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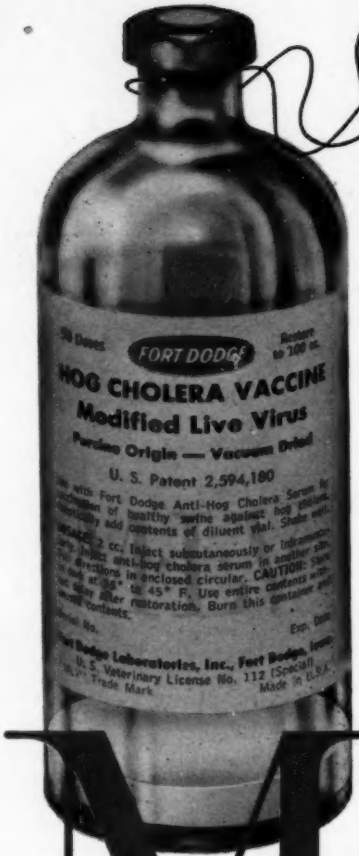

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Why Do Cows And Sheep Bloat?

R. E. NICHOLS, D.V.M., M.Sc., Ph.D., D.V.Sc., Madison, Wisconsin

NO one who has raised many cattle or sheep can deny that he occasionally can be hurt financially, sometimes disasterously, when he attempts to obtain maximum use of the excellent production of fresh legumes as pasture. There appear to be times when these plants just do not seem to suit the digestive system of the animal; yet their economic potentialities necessitate that their maximal use be developed to provide adequate food for a world rapidly becoming overpopulated. Many specialists have been, and are, doing excellent research to discover why bloat occurs. Results obtained through many and various avenues of approach to determine the exact cause of acute bloat suggest that our interpretations may have been largely a matter of examining "trees instead of the forest", *i.e.*, emphasis on much detail of possible contributing factors instead of fitting these factors into the general pattern of the normal, and some of the abnormal, digestive functions of the paunches of these animals. To find the practical answer, the latter is a most necessary step.

If we examine the experiences of those who have observed this disease in a general way, without getting too critical about individual details, we find a pattern of circumstances which leads to these general assumptions:

1. Acute bloat apparently is more prevalent in animals consuming legumes.
2. It is more prevalent when legumes are pastured.
3. It is more prevalent when legumes are young and not stemmy.
4. Some of the time it occurs shortly after turning animals onto legume pastures for the first time.
5. It occurs also after animals apparently have become accustomed to, and have consumed, considerable legume pasture.
6. Apparently it is less prevalent when legumes are pastured in the mature state.
7. It is less prevalent when animals consume grasses and coarser feeds along with legumes.
8. Apparently it can be produced by cutting and stable-feeding leafy legume tops.
9. It is not necessarily associated with eating excessively large quantities.
10. It comes on quickly.
11. Not all animals in a herd bloat.

The Author

Dr. R. E. Nichols

12. Where the condition is prevalent, some cows will bloat; some never do.

13. Apparently it is less prevalent when animals are not allowed to get too hungry or too thirsty.

14. Greedy animals and high producers appear to be more susceptible.

15. It does not seem to be related to any particular locality, soil condition, or fertilizing practice, except insofar as these affect the botanical composition of pastures.

16. It often seems to be associated with humid weather, rainy spells, wet seasons, dew, frost, irrigation, etc.

17. In sheep, particularly, it may follow watering the animals just before they are turned out.

18. Heavy feeding of grains to "finish" animals may result in bloat; the same animals returned to coarser feed usually have no further trouble.

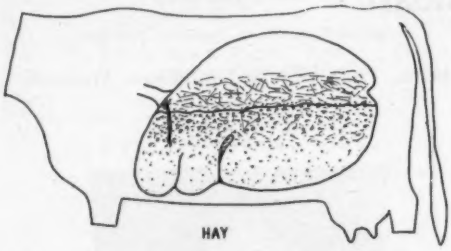

Fig. 1. Character of Paunch Contents when Hay is Predominant in the Ration. The liquid level during relaxation of the reticulum and anterior rumen is usually somewhere between the cardia and the reticulo-omasal orifice. During contraction of the reticulum and anterior rumen, the fluid usually floods the cardia. Newly introduced hay floats on the liquid. As the hay is soaked and comminuted, small particles tend to sink into the paunch fluid. The mixing motions of the organ never accomplish a complete mixture of the contents. Because they are light, hard and dry, hays soak and comminute slowly. Longer rumination times are necessary. Because their density favors floating on the paunch liquid and thus delay in their preparation and ultimate passage into and through the paunch fluid to the omasum, hays that are not fine ground undergo much of their gaseous digestion before the small particles finally reach the lower levels of the paunch. The bubbles leave the paunch particles and liquid easily and coalesce to form a large bubble in the dome of the paunch. Little foam remains at the fluid level. Particles which do sink and have not yet been attacked by gas producers will float to the top as they are buoyed up by the gas formed from them and attached as bubbles. When the bubbles break away, the particles sink again. The small particles of food in the fluid of the lower levels of the paunch eventually pass through the reticulo-omasal orifice. Any larger particles which accidently escape into the omasum are further delayed by enmeshing between the papillate of the omasal leaves. Maximum gas production has occurred before the small particles reach the omasum; thus gas production in the omasum, apparently, is not of much importance. Soft leafy hays of higher density behave in the paunch more like the mature green plants from which the hays were made.

We find among the many theories as to the cause of bloat a few generally accepted assumptions such as:

1. Legumes probably produce no more gas than grasses.

2. There probably is little difference in the kinds of gases produced from legumes and those produced from grasses.

3. The difficulty in bloat is probably one of *inability to eliminate gas*, rather than an overproduction of gas.

4. The reason for the inability to belch enough gas is not yet understood; neither is the normal function of belching.

5. Feeding coarser feeds with legumes seems to prevent bloat although there appears to be considerable controversy as to the reason.

Beyond these factors, there has not been too much agreement. This confusion has been a logical result of lack of sufficient background information. Much has been learned, nevertheless, about many functions associated closely with the bloat problem, even though little about the real cause of bloat has been uncovered.

If we review the anatomy and physiology of the pertinent portions of the digestive tract of the ruminant, we can demonstrate to ourselves the following:

1. The entrance to the paunch is not at the top, but several inches below the dome of the organ, at least mechanically affording an opportunity for the accumulation of relatively large quantities of gas in the dome.

2. The exit of the reticulum is not at the bottom of the organ but is several inches above the bottom and only a short distance from the entrance to the paunch. Thus, the food does not merely go in one end and out the other; most of it is *delayed* in its passage through the paunch and reticulum to allow adequate microbial digestion.

3. Microbial digestion associated with gas formation is apparently greatest immediately following feeding.

4. The amount of fluid in the paunch in the normal animal apparently is maintained at a level, which, during relaxation of the reticulum and lower rumen, will allow exposure of the

cardia to the gas collected in the dome. Mechanically at least, this will allow the possibility of belching most necessary at times following intake of feed.

5. The specific motions of the rumen and reticulum are not the kind that resu't in a homogenous mixture of the contents of the organs. The consistency and degree of digestion of their contents apparently differ in different areas, even when the animal is fed the same kind of feed.

6. Feeds of various kinds seem to follow different avenues in traversing the paunch. Heavier feeds, such as the concentrates which require less time to be prepared for fermentation, seem to gravitate more quickly into the fluid of the lower portions of the paunch than do the lighter feed substances such as hay. The lighter, coarser, and less easily soaked feeds seem to remain in the paunch the longest and require more preparation than the green feeds. Yet, these same feeds, when ground, behave more like the concentrates.

Perhaps it is a coincidence that the two kinds of feeds most commonly incriminated in b'oat are the two (legumes and ground feed) which apparently have a tendency to sink more rapidly toward the bottom of the paunch. Perhaps it is a coincidence that the two kinds of feed (hays and grasses) least incriminated in bloat are the kinds which tend to be retained higher in the rumen for a longer time. They are the kinds on which the ruminating species developed over the centuries. Grains and legumes were probably not consumed by the early wild cattle in the concentrations that they are fed today; grass and hay probably were. Is it unreasonable to assume that the ruminants may not be suited anatomically and physiologically to too heavy concentrate feeding because their digestive apparatus and mechanisms did not develop in that direction? Recognition of minor differences in structure and function of the pertinent portions of the ruminant digestive apparatus, as well as differences in behavior patterns of individual animals, if more clearly defined, may well offer reasonable evidence as to why, under what appear to be similar conditions, some animals will b'oat and some wi'l not.

There is evidence leading to a plausible reason why animals sometimes bloat on fresh legumes and on large quantities of grain even though they may be safely fed most of the time and may not be "toxic" in the usual sense of the term. This evidence is suggested by the results of two research studies. Results of the first study indicated: (1) That enough

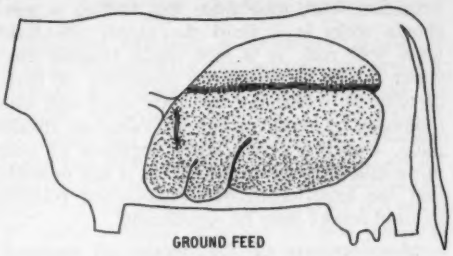

Fig. 2. Character of Paunch Contents when Ground Feed is Predominant in the Ration. The particles of ground feed, small in size and devoid of coatings not easily soluble, and the air spaces of hays, grasses and mature legumes, tend not to float on the paunch fluid but sink into it fairly rapidly. Because of small particle size, the ease of soaking, and semi-fluid nature of the contents, the motions of the paunch can mix the contents more completely. Small bubbles formed on the food particles do not detach and coalesce easily. Much foam is formed and eventually the entire paunch cavity may consist of a semi-fluid, frothy mass. Even ground hay can produce a froth of small bubbles, though the same hay, when not ground, will not. As the froth of the ingesta becomes more extensive, the fluid level rises and gradually becomes less distinct. Adequate reduction of surface tension of bubbles on and within the frothy mass will result in ultimate exposure of the cardia to free gas.

water could be introduced into the paunches of sheep to prevent belching but that such treatment, with water a'one, did not endanger the animals; (2) that gases ordinarily found in paunch gas could be introduced into the paunches under pressures similar to those demonstrated in bloated animals and would be belched with ease with no apparent harm to the animals; but (3) if the water was pumped into the paunches *first* and then the same pressures of the same gases applied, the sheep would die quickly. This would seem to be good evidence that an increased fluid level in the paunch can mechanically inhibit belching.

Results of the second research study suggest reasons why legumes, because of their tendency to gravitate more quickly to the lower portions of the paunch, establish conditions conducive to the inability of the animal to belch the increased amount of gas normally produced following the arrival of new unfermented feed in the paunch. Measurements of the density of the centrifuged juice from the lower portions of the paunch indicated that the intake of water lowered the effective buoyancy of the fluid portion of the juice regardless of the ration fed. Since the occurrence of bloat has been associated at times with water intake, frost, dew, rainy weather,

irrigation, etc., and since the farther a substance sinks in a fluid the higher the fluid level will rise, is it not quite feasible that water intake increases the possibility of bloat directly by increasing the fluid level and also indirectly by reducing the buoyancy of rumen juice, allowing newly eaten legumes to sink more quickly into the fluid? Is it not possible that the experiences of livestockmen relative to fluid intake may be significant?

Measurements of the density of strained, but not centrifuged, juice from the same area of the paunch indicated that even in the absence of the effects of water intake, the feeding of fresh legumes reduced the effective buoyancy of rumen juice considerably more than when either fresh grass or hay was fed. The amount of reduction in buoyancy was directly related to the quantity of gas bubbles formed by microorganisms on the small particles of feed in the juice. The more bubbles there were formed, the greater was the reduction in buoyancy of a given volume of the juice. It also was observed that the reduction in buoyancy due to bubble formation extended over to the next day much more so with legumes than with grass or hay. Because of the decreased buoyancy of the paunch juice, due to the presence of more bubbles in it, recently eaten fresh legumes quickly gravitated into the juice and did not remain near the top as was true with hay and, to a lesser extent, grass. Since each food particle and each bubble attached to a food particle in the juice, or otherwise trapped in it, displaced an equal volume of liquid upward, the fluid level was higher in the animals when they were fed fresh legumes than when they were fed grass or hay. Additional evidence of this was the observation that usually more fluid spilled out around the plugs of the fistulas of animals when they were fed fresh legumes than when they were fed grass or hay, despite the fact that they consumed much less water while being fed the legumes. The bubbles of gas formed on the food particles of samples of juice from the bottom of the paunch were more numerous during legume feeding and were generally smaller. They did not coalesce to the same extent as they did during grass or hay feeding. The rumen content of the animals was always frothy, but it was certainly more so during legume feeding.

Is it not conceivable that the lower position in the paunch assumed by legumes, during their gaseous digestion, would be aggravated if there were any increase in the density of the plant during its young growing stage? Among other things, we need to know if

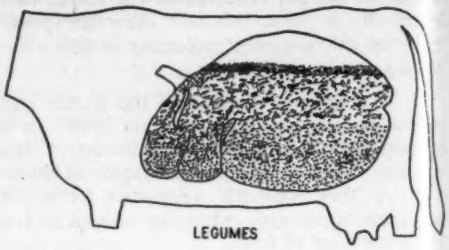

Fig. 3. Character of Paunch Contents when Fresh Young Legumes are Predominant in the Ration. Fresh, young, leafy legumes appear to be more dense, more easily wetted and gravitate more rapidly than fresh grasses. Small bubbles are formed on, and seem to stick to, the legume material more than to grass. Feeding fresh, young and leafy legumes results in small bubble froth on and within the paunch contents. Froth may at times be extensive. The fluid behaves much as with ground feed. It rises by displacement of liquid upward by the sinking feed and the clinging bubbles on it. Adequate reduction of the surface tension of bubbles on and in the paunch fluid can result in eventual exposure of the cardia to gas.

there are differences in the density of legumes and grasses; if there are stages of growth where density is increased, and if wet humid weather, rapidity of growth, and leafiness alter density and other factors. Leaves of red clover have a density of expressed juice greater than that of stems of the same plant.

Is it not conceivable that there can be the right combination of circumstances which will raise the fluid level enough to stop belching at a time when normal gas production is approaching its peak and belching is most necessary? Is it not also possible that some minor alteration in the plant may eventually eliminate the danger of bloat; some alteration which will result in legumes traversing the paunch more like roughages and less like concentrates. Concentrates, if fed in large enough quantities, can produce bloat and possibly, for the same reasons, they undergo gaseous digestion deep in the paunch fluid instead of near the top. Perhaps this is true also with ground hays.

It was observed several years ago that gas determinations in glassware washed with detergents, and not adequately rinsed, were unreliable. In some, gas production was nearly stopped. In others, bubbles formed by microbial invasion of food particles seemed to break away from the particles with greater ease. Because of this observation, the effects of a few of the common household detergents and surface-active agents on the effective buoyancy of rumen juice and the character of rumen

contents were determined. Administration of some of these agents increased the effective buoyancy of rumen juice and cleared the paunch of froth. Some were not desirable. The possibility that low-level feeding of any of several of the detergents and surface-active agents in appropriate quantities and at adequate intervals may modify the position in the paunch and the manner in which legumes undergo gaseous digestion is intriguing to say the least, but not without difficulties and dangers. Their use will be justified, nevertheless, if they will save cows from bloat. Research is now under way to find how to feed, what kinds to feed, how much, and how often. Before they can be accepted as reliable, it must be determined that they are not toxic and do not materially interfere with the digestibility of the feed, which some of them could well do, especially those used to clean milking equipment. Even if a kind and quantity is found that will allow stockmen to live with legume bloat, the problem still remains: to find the incriminating characteristics, physical or chemical, of legumes and remove them by selective breeding. There are many challenging possibilities in this direction. Perhaps varieties with a little more fuzz on the leaves or with less pithy stems, or those that mature quickly may be safe ones to pasture. Research will tell.

Equally as exciting is the thought that by no means have there been exhausted all of the possibilities of producing, by management practices alone, the desired safe position of gaseous digestion of legumes in the paunch. It appears quite evident that the same safe condition of paunch contents, as apparently produced by some of the detergents and surfactants, can also be produced by management practices, provided each and every animal takes into its paunch, each and every day, sufficient roughage of less density than fresh young legumes to keep the legumes from sinking too rapidly in the paunch fluid, even though this seems to be prevention by substitution rather than greater use of legumes. Certainly it is possible to arrange such a feeding schedule with the addition of grass or hay or by cutting fresh legumes, stems included, and feeding them in the manger or bunk. It is doubtful that the animal itself, if given free choice, will arrange its own feeding schedule to comply with these requirements all of the time. Whether it is practical may be another question. The balance of increased production costs against increased yields may well be in favor of fresh legumes, especially as the world becomes more and more populated.

Porcine Leptospirosis

Abortion has been a common symptom in several outbreaks of leptospirosis in swine in Illinois, according to report appearing in the current (February) issue of *Timely Topics*. It usually has occurred during late gestation. Some full-term pigs may be born dead or die shortly after birth. During an outbreak in one herd, pigs farrowed by affected sows did poorly, some revealed icterus. In this instance, however, the drove appeared healthy and grew normally after weaning. Fever, loss of appetite, bloody urine, jaundice, anemia, abnormal milk and reduced milk flow have been observed as symptoms in some sows.

Laboratory diagnosis may confirm suspects by demonstrating organisms in aborted swine fetuses or in the kidney or liver of affected hogs. Correlation of symptoms with positive blood tests are also diagnostic aids. Clear serum samples should be sent to the laboratory for testing to prevent troublesome hemolysis. Freshly aborted pigs, or blood samples from aborting sows, also may be submitted for bacteriologic and serologic examination. Differentiation of leptospirosis from other causes of icterus or abortion in swine should be accomplished in the laboratory.

Recommended for prevention and control is isolation of sows that abort and disposal of fetal membranes by burning or deep burial.

Avoid contact of cattle with infected swine or the premises where isolated. One attack of the disease apparently confers resistance, as infected sows have been rebred and have farrowed normal litters. Prophylactic vaccine is in the experimental stage. Some recovered sows remain as carriers and are thought to be sources of infection. They also constitute a hazard to persons working with them.

▾ ▾ ▾

The value of business economic forecasts are questioned, whether they be optimistic or pessimistic. A famous economist, Dr. Julius Hirsch predicted in 1944 that, "The best we can hope for, after the first postwar replenishment, is a national income between $100,000,000. and $108,000,000., and an employment of 47,000,000 to 49,000,000, not including those in public works." How far in error the best qualified can be exists in the facts that the total personal income of Americans in 1953 was $280,000,000., almost three times the amount forecast, and approximately 62,000,000 persons were employed during the same period, notwithstanding the famous Doctor Hirsch's predictions.

The Production Of Bovine Hyperkeratosis (X disease) With An Experimentally Made Pellet Feed†

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EVIDENCE has been presented by various workers that bovine hyperkeratosis (X disease) is caused by a toxic substance or substances. Several different materials, including some feedstuffs, have been found capable of producing the disease. A particular lot of pelleted, dehydrated alfalfa was related to an outbreak by Olson, Cook, and Brouse[10]. Olafson and McEntee[9] produced hyperkeratosis in cattle with a processed concentrate, and the free fatty acid fraction of the ether extract of the concentrate was found to be toxic by McEntee, Hansel, and Olafson[6]. Miller, Bortree, and Shook[7] were able to produce the disease with a particular crop of timothy hay. Among the non-feedstuffs found to be capable of causing bovine hyperkeratosis are one lot of wood preservative used in Germany and reported by Wagener,[12] a particular lubricant described by Bell,[1] and some asphalt roofing paper reported by Link (cited by Lee[6]). The identity of the toxic substance in some of these materials has been established. Bell[2] found that highly chlorinated naphthalenes were toxic substances in the lubricants found capable of producing bovine hyperkeratosis. Sikes and Bridges[11] also have described the production of bovine hyperkeratosis with various chlorinated naphthalenes, the relative toxicity of which have been studied by Bell[3]. Olafson, McEntee, and Hansel[9] found that the German wood preservative contained two active fractions. One of these was identified as a chlorinated naphthalene, while the other possessed properties close to those of trichlorobenzene.

The establishment of the toxicity of the chlorinated naphthalenes, and of the lubricants containing these compounds as chemical additives, led to speculation about their presence in certain pelleted feedstuffs. This report describes the results of a study made of the possible contamination of a pelleted feed during the pelleting process.

Materials and Methods

The pellets were prepared for the study by a local feed mill. Prior to the pelleting process, the rolls of the pellet mill were removed and thoroughly cleaned. They were then weighed, lubricated with lot I lubricant (which contained no chlorinated naphthalenes), reweighed, and replaced. A one-pound, lever-type, pressure grease gun was used to lubricate the rolls. Three ounces of lubricant were used in the lubrication of the rolls prior to the pelleting of the first ton of feed. One ton of feed was then pelleted (lot A pellets) with no further lubrication of the rolls. Lot I lubricant was then added to the rolls, which were not removed from the pellet mill, at the beginning of the pelleting of the second ton of feed and at ten-minute intervals thereafter (lot B pellets). Eight ounces of lubricant were used during the pelleting of lot B pellets. At the completion of the pelleting of the second ton (lot B pellets), the rolls were removed, weighed, then cleaned and reweighed. They were lubricated then with lot II lubricant (which contained 3% chlorinated naphthalenes), weighed and replaced in the pellet mill. Three ounces of lubricant were used in the lubrication of the rolls prior to the pelleting of the third ton of feed. The third ton of feed (lot C pellets) was pelleted with no further lubrication of the mill. At the completion of the pelleting of the third ton of feed, lot II lubricant was added to the rolls, which were not removed from the mill, at the beginning of and at ten-minute intervals during the pelleting of the fourth ton of feed (lot D pellets).

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Thirteen ounces of lubricant were used during the pelleting of lot B pellets. The rolls were removed and weighed at the completion of the process. The bags of pellets in each lot were numbered in the order they were made.

Calves weighing from 170 to 260 lb. were obtained, at weaning age, from the herds at the Virginia Polytechnic Institute, placed in individual stalls, and two calves assigned to each lot of pellets. The pellets were stored in containers and were fed in the order they were made. Separate feed and water buckets were provided for the calves on each lot of pellets. Each calf was fed twice daily the amount of pellets it would consume. All calves received once daily a small amount of home-grown, mixed orchard grass and alfalfa hay. Body weights were obtained and serum vitamin A levels were determined according to the method of Kimble[4] at 14-day intervals.

Five additional calves were obtained from the same source. Fifty grams of lot I lubricant, divided into small doses, were given orally, in gelatin capsules, to calves 1555 (wt. 190 lb.) and 1558 (wt. 233 lb.) over a period of eight days. Calf 1560 (wt. 223 lb.) received orally, in gelatin capsules, 30.6 gm. of lot II lubricant, given in divided doses over a period of seven days. Calf 1561 (wt. 211 lb.) received orally, in gelatin capsules, 58.6 gm. of lot II lubricant, given in divided doses over a period of 16 days. These four calves were handled in the manner previously described by Bell[1,2]. Calf 1531 served as a control.

Results

The calves, 135 and 137, fed lot A pellets and the calves, 138 and 139, fed lot B pellets had good appetites and consumed their feed regularly. Little or no trouble was experienced in keeping these calves on feed, and their daily weight gains were good (tables 1 and 2). These calves exhibited no symptoms of bovine hyperkeratosis during the 135 days of feeding, and no evidence of gross pathology was present at autopsy. Histological examination of tissues revealed no microscopic changes similar to those occurring in bovine hyperkeratosis. The serum vitamin A levels (table 3) of calves 135, 137, 138, and 139 remained well above values that may be considered deficient.

The calves 141 and 142, fed lot C pellets and the calves 146 and 147, fed lot D pellets were erratic in feed consumption (table 1). They often refused the pellets and their weight gains were less than those of the calves on lots A and B (table 2). The vitamin A levels of these calves fluctuated, and at times were at levels indicating a deficiency. The vitamin A levels, in general, were consistently below those of the calves fed lots A and B pellets (table 3). Symptoms of bovine hyperkeratosis

TABLE 1. Pounds of Feed Consumed per Week.

	Calf Number							
Weeks	135(A)*	137(A)	138(B)	139(B)	141(C)	142(C)	146(D)	147(D)
1	12.2	19.0	18.5	15.2	16.0	9.8	19.0	15.0
2	21.8	30.2	29.5	27.0	20.5	5.5	24.5	22.0
3	35.5	38.0	37.5	26.2	18.8	12.5	25.2	32.2
4	40.0	28.0	40.0	27.8	16.2	7.5	28.8	27.0
5	42.0	39.0	37.8	34.8	7.8	7.0	30.5	28.5
6	43.0	42.5	42.2	42.2	5.0**	7.2	31.0	33.5
7	49.5	44.5	42.5	42.5		10.0	32.5	38.0
8	48.8	41.5	38.8	38.8		16.5	35.0	42.0
9	52.5	42.0	42.0	42.0		12.8	42.0	42.0
10	52.5	44.0	44.0	44.0		13.5	44.0	38.5
11	52.5	36.5	49.0	49.0		6.5	42.5	21.0
12	52.5	46.0	51.0	51.0		2.8***	45.0	25.5
13	52.5	52.5	52.5	52.5			52.5	34.0
14	52.5	52.5	52.5	52.5			52.5	42.5
15	52.5	52.5	52.5	52.5			52.5	36.5
16	56.0	56.0	56.0	56.0			55.5	39.0
17	56.0	56.0	56.0	56.0			56.0	45.5
18	56.0	56.0	56.0	56.0			47.5	40.8
19	56.0	56.0	56.0	56.0			54.5	34.0

*Letters indicate lot of pellets fed.
**Calf 141 lived 41 days. Sixth week contains six days.
***Calf 142 lived 82 days. Twelfth week contains five days.

appeared in the calves fed lots C and D pellets. The calves on lot C, 141 and 142, developed pronounced symptoms and were considerably more affected than were the calves, 146 and 147, on lot D.

Calf 141 developed profuse lacrymation, anorexia, and some depression on the 15th day. The symptoms persisted and the calf became extremely weak, dying on the 41st day (figure 1). The gross lesions at autopsy included: Enlarged, pale kidneys; enlarged liver, with several pale areas on the surface that extended into the parenchyma; distended gall bladder, wall thickened; extensive wart-like proliferations on roof of mouth and dental pad; several proliferative lesions on tongue; some inflammation of abomasum and small intestine; and some pneumonia in lower portion of anterior lobes of the lungs. Microscopic changes included: Fibrosis and some bile duct proliferation in the liver; dilatation of the tubules of the renal cortex; squamous metaplasia of the seminal vesicles (figure 2) and epididymis; and some keratinization of the hair follicles.

TABLE 2. Feed Consumption and Weight Gains

Calf No.	Pellet	Days on Feed	Total Gain lb.	Ave. Daily Gain lb.	Total Feed Consumed lb.	Avg. Daily Feed Consumption lb.
135	A	135	270	2.00	884.25	6.55
137	A	135	281	2.08	832.75	6.17
138	B	135	255	1.89	854.25	6.33
139	B	135	252	1.87	822.00	6.08
141	C	41	—27	—0.65	83.75	2.04
142	C	82	0	0.00	111.50	1.36
146	D	135	232	1.71	771.00	5.71
147	D	135	159	1.18	637.50	4.72

Calf 142 was lacrimating on the 24th day. This symptom was followed by depression, nasal discharge, and partial anorexia. These symptoms persisted, and by the 82nd day depression was marked, anorexia complete, and the calf extremely weak. The calf was sacrificed at this time. Gross changes included: Many white areas, up to one-half inch in diameter, on the surface and extending into the cortex of the kidney; several yellow areas on the surface and extending into the parenchyma of the liver; three or four cyst-like structures on the floor of the vagina near the anterior end; and retarded horn growth. Microscopic changes included: Liver cell degeneration and bile duct proliferation; squamous metaplasia of the ducts of the parotid gland; dilatation of the tubules of the renal cortex; squamous metaplasia of the epithelium of Gartner's ducts; and slight keratinization of the hair follicles.

Fig. 1. Depression, lacrimation, and wrinkling of skin in calf 141 after 41 days on lot C pellets.

Calf 146 began to refuse the pellets on the 17th day, and red areas appeared on the oral mucosa, gums and lips on the 33rd day. The daily feed consumption was irregular, and polyuria was evident. Gross examination at autopsy on the 135th day revealed: Slightly enlarged kidneys with numerous pale areas on the surface extending into the cortex; some fibrosis of the liver; and marked retardation of horn growth. Microscopic examination of tissues revealed: Some dilatation of tubules of renal cortex and fibrosis of kidney; slight bile duct proliferation and fibrosis of the liver; and squamous metaplasia of the epididymis.

Calf 147 refused the pellets on the 17th day,

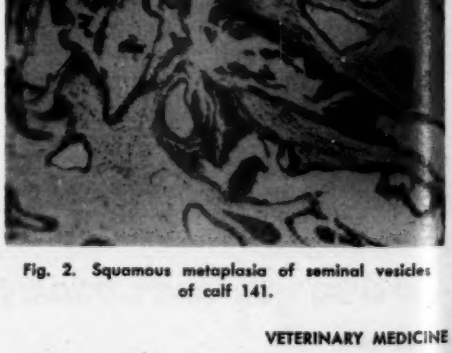

Fig. 2. Squamous metaplasia of seminal vesicles of calf 141.

and the feed consumption was irreglar throughout the remainder of the 135-day feeding period. Some lacrimation was present at times, and the calf was depressed constantly. When autopsied on the 135th day, the horn growth was markedly retarded (figure 3). Other changes noted were: Slightly enlarged kidneys with pale areas extending into the cortex; some evidence of bile duct proliferation and fibrosis of the liver; and several flat ulcers in the abomasum. Microscopic examination of tissues revealed: Dilatation of tubules of renal cortex (figure 4); degeneration of tubule cells and fibrosis of kidney; degeneration of liver and bile duct proliferation; dilatation of mucous glands of the gall bladder; and squamous metaplasia of the epithelium of the seminal vesicles.

Calves 1555 and 1558, given oral administration of lot I lubricant (containing no chlorinated naphthalenes), and the control calf (1531) did not develop clinical symptoms, or gross and microscopic lesions of bovine hyperkeratosis. Calves 1560 and 1561, given oral administration of lot II lubricant, developed symptoms of bovine hyperkeratosis. Marked lacrymation and depression appeared on the fourth day, and thickening of the skin (figure 5) and proliferations of the oral mucosa had developed before autopsy on the 45th day. Gross changes included: Proliferations on the nostrils, lips, dental pads, and gums; marked hyperkeratosis; enlarged kidneys; enlarged epididymis; cyst-like nodules in the gall bladder mucosa; and several flat ulcers in the abomasum. Microscopic examination revealed: Dilatation of kidney tubules; bile duct proliferations; squamous metaplasia of the epididymis; dilatation of mucous glands of the gall bladder; and an accumulation of keratinized material on the skin.

Discussion

The response of calves 1555 and 1558 to lot I lubricant, which contained no chlorinated naphthalenes, demonstrated that it was not toxic. Similarly, the calves fed lots A and B pellets, made with the pellet mill lubricated with lot I lubricant, did not develop symptoms and lesions of bovine hyperkeratosis. Their average daily gains, excellent appetites, and vitamin A levels were further evidence of the lack of toxicity of these lots of pellets. The development of the calves on these pellets indicated that they were fed an adequate ration.

The calves administered lot II lubricant, which contained 3% chlorinated naphthalenes,

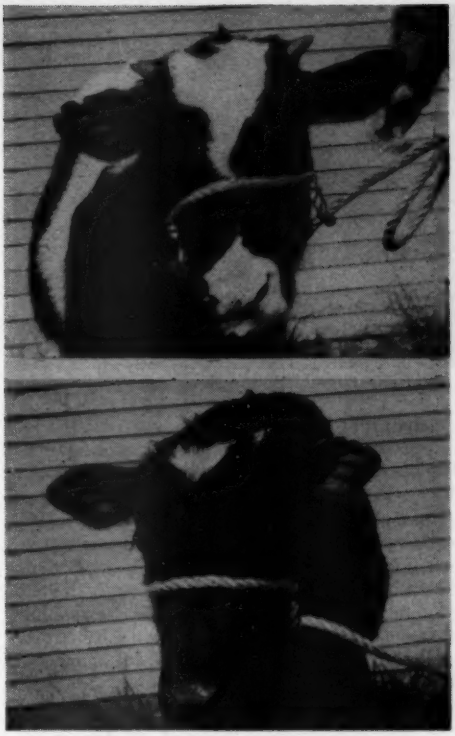

Fig. 3. Normal and retarded horn growth in calves 137 (above) and 147 (below) respectively.

developed typical symptoms and lesions of bovine hyperkeratosis, demonstrating the toxicity of this lubricant. The response of the calves fed lots C and D pellets, made with the pellet mill lubricated with lot II lubricant, indicated these pellets were toxic. In addition to the irregular feed consumption and low gains, symptoms and lesions associated with bovine hyperkeratosis developed in the calves on these lots of pellets. Further evidence of the toxicity of lots C and D pellets was afforded by the serum vitamin A levels of the calves. These levels were considerably below those of the calves fed lots A and B pellets and at times were at levels that can be considered indicative of a deficiency. This effect of hyperkeratosis-producing substance on vitamin A metabolism has been described by Olafson, McEntee and Hansel[9].

The toxicity of lot C pellets was greater than that of the lot D pellets. The calves, 141 and 142, fed lot C pellets in the order they were made died or had to be sacrificed when only 195.25 lb. of the pellets had been consumed.

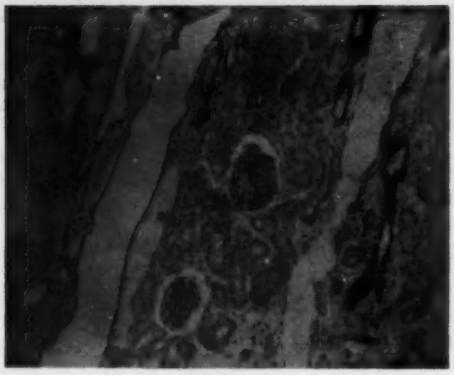

Fig. 4. Dilatation of kidney tubules of calf 147.

On the other hand, calves 146 and 147, fed lot D pellets, survived the entire period of study. The results appear conflicting since only 3 oz. of lot II lubricant were introduced into the clean pellet mill rolls prior to pelleting lot C, whereas 13 ounces were introduced during the pelleting of lot D pellets. The explanation of the difference in toxicity of the lots of pellets may lie in this difference in the lubrication procedure. To investigate the possibility of the concentration of the toxicity of lot C pellets in the first few hundred pounds, two additional calves were placed on these pellets. Calf 1603 was fed the pellets beginning at the place where calves 141 and 142 stopped. Calf 1595 was started on the last bag and fed the pellets in the reverse order to which they were made.

Calf 1603 developed lacrymation 26 days after being placed on the lot C pellets. This symptom was followed by depression, anorexia, and development of red areas in the mouth. These symptoms persisted in varying degrees of severity until the 60th day. After the 60th day the calf appeared free of clinical symptoms, except for an irregular appetite, for the remainder of the 171-day feeding period. The average food consumption was 4.69 lb. and the average daily gain was 1.01 lb. Serum vitamin A levels at the 13th, 41st and 48th days were 2.80, 1.92 and 6.78 micrograms per 100 ml., respectively. It was 10.26 micrograms per 100 ml. on the 78th day and ranged between nine and 14.4 micrograms per 100 ml. for the remainder of the feeding period. Calf 1595 failed to show clinical symptoms except for some irregularity in feed consumption. In general, its appetite was good during the 190-day period. This calf had an average daily food consumption of 5.77 lb. and an average daily gain of 1.65 lb. Serum vitamin A levels were never low, and, in general, ranged from about 20 to 25 micrograms per 100 ml. The lowest value obtained was 11.45 micrograms per 100 ml. on the 14th day. Gross examination of calf 1603 at autopsy revealed some enlargement of the liver, a few small nodules in the mucosa of the gall bladder and in the large bile ducts, and a few white areas on the surface and extending into the cortex of the kidney. Gross examination of calf 1595 revealed some enlargement of the liver. Micro-

TABLE 3. Serum Vitamin A Levels in Calves Fed the Experimentally Made Pellets

Days of Feeding	Calf Number 135(A)*	137(A)	138(B)	139(B)	141(C)	142(C)	146(D)	147(D)
	Micrograms/100 ml.							
17	30		14		4		12	
27		24		23		22		30
34	29		19		13		20	
41		47		32	4**	11		3
48	48		25				0	
55		28		24		15	1	8
62	70		56				23	
69		29		19		0		0
76	54		32			8	14	18
83		51		47		16***		22
90	44		38				19	
97		28		24				9
104	44		34				9	
118	33		28				14	
125		30		18				4
132	36		17	19			19	18

*Letters indicate pellet lot.
**Died on 41st day.
***Determined on 82nd day, prior to death.

scopic examination of tissues taken from calf 1603 revealed some degeneration and fibrosis in the liver, some squamous metaplasia of the epididymis and ducts of the parotid salivary gland, and dilatation of the tubules in a few areas of the renal cortex. Similar examination of tissues from calf 1595 showed a slight amount of liver fibrosis.

The response of calves 1595 and 1603 fed the remainder of the lot C pellets, in the manner described, indicated that the toxic substance was concentrated in the first few hundred pounds of pellets made.

The response of calves 146 and 147, fed the lot D pellets, indicated that the toxic substance was not concentrated but was irregularly distributed throughout the ton of pellets in small amounts. Evidence that this was the case was furnished by the erratic consumption of the pellets by the calves, by the intermittent symptoms, and by the serum vitamin A levels. The supposition that the toxic substance was irregularly distributed in the lot D pellets was further supported by the data obtained on the weights of the pellet rolls. During the pelleting of lot D pellets the 13 oz. of lubricant were introduced in approximately 1¾ oz. portions. These were introduced into the rolls of the pellet mill at the beginning and at ten-minute intervals during the pelleting of the lot D pellets. The weight of the rolls, when removed after the pelleting of lots B and D pellets, was the same as it was when cleaned prior to use. Since the rolls were lubricated not more than ten minutes before the pelleting stopped it is apparent that the lubricant disappeared within this time or possibly in a shorter time. It is likely, therefore, that each portion of the 13 oz. introduced at ten-minute intervals also disappeared rapidly from the rolls and that toxic substances were not concentrated in a few hundred pounds.

Summary

Calves fed pellets made when the pellet mill was lubricated with a lubricant that did not contain highly chlorinated naphthalenes did not develop symptoms and lesions of bovine hyperkeratosis. Calves fed pellets made when the pellet mill was lubricated with a lubricant containing chlorinated naphthalenes developed symptoms and lesions of bovine hyperkeratosis.

Acknowledgments

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Fig. 5. Hyperkeratosis in calf 1560 after administration of 30.6 gm. of lot II lubricant which contained 3% chlorinated naphthalenes.

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(Continued on page 106)

PRINCIPLES OF ANIMAL HEALTH

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Control of External Parasites During Stabling Period

During the stabling period of the year cattle may begin to itch, and veterinarians are called upon to make accurate diagnoses. Sarcoptic mange with the parasite lodged quite deeply in the skin, is difficult of detection unless deep skin scrapings are taken. Chorioptic mange is simpler as the parasite is comparatively superficially lodged under scabs. Psoroptic mange is similar in its manifestation to the Chorioptes. Demodectic mange is said to occur at all seasons in cattle; however, in my personal experience, no case of follicular mange has been observed in cattle, although seen relatively frequently in dogs. By means of the newer insecticides, such as benzene hexachloride, lindane, methoxychlor, and others used on the animals (methoxychlor is one of those that may be used on dairy cows) as well as disinfectants used on woodwork and manure piles, mange mites may be brought under control. Clipping is helpful but blanketing may become a necessity.

Lousiness is a problem on all farms. These parasites spend their entire existence on the host's body. There are at least three rather common species of sucking lice and one biting louse that may infest cattle. Their control by liquid insecticides, with treatment repeated after an interval of ten days to destroy those that have hatched from the nits, is the method of handling recommended. A powder containing from 3 to 10% of the active toxic agent in pyrophylite is one of the combinations used in cold weather when liquids are objectionable. Lindane and DDT are not to be used on cows in milk production, as these agents are later detectable in the milk and thus are potentially harmful to human beings.

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Self Delousing Apparatus

From the Oregon Agricultural Experiment Station comes the announcement of the almost complete control of cattle lice by a "rubbing device", which consists of cables with burlap treated at 30-day intervals with 5% chlordane in fuel oil. Cattle in the feed lots rid themselves of lice by rubbing against the cable.

Sex Ratio Unaltered by Artificial Insemination

Occasionally the statement is made that, as a sequence to artificial insemination in cattle, the sex ratio of the progeny is altered. Normally, there are approximately 51% bull calves and 49% heifers—almost a 50-50 ratio. Artificial insemination does not change this ratio. It makes no difference to the sperm how it gets into the female genitals; whether by natural or artificial means, sex ratio, determined by careful observation on many artificially inseminated cows, remains the same.

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Human Brucellosis

In a recent issue of the *Am. Jour. of Med. Sci.* concerning human brucellosis, we noted the statement, ". . . that Brucella has the ability to multiply within certain cells including macrophages, and that soluble antibiotics seem to be incapable of penetrating the cell-membrane . . ." The authors report best results in human brucellosis patients following a series of hypodermic injections of amphoteric terramycin, "in amounts not larger than 160 mg. per week." Blood cultures became negative shortly after 15 days of treatment.

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Results of Animal Disease Control Efforts

It is officially reported that for the fiscal year ending June 30, 1953, the tuberculin test showed reactors of a total of 0.11% of 9,675,245 cattle tested. This may be compared with the 4 and 5% reactors found as the national average in 1917-1918 when eradication efforts were started in earnest. During the same fiscal year, the testing for brucellosis of 660,334 herds, or 7,860,870 cattle, indicated 3.4% reactors. However, the "ring test" showed infection existing in 175,909 out of a total of 670,532 herds thus tested. Since the ring test was authorized as a supplementary test in January 1941, it has been applied to 1,174,290 herds, of which 311,876, or 27%, were shown to contain infected animals.

Control Of Internal Parasites Of Cattle By Free-Choice Administration Of Phenothiazine

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DURING the past decade, free-choice administration of phenothiazine in salt and mineral mixtures has been employed extensively and, in general, successfully, for the control of gastrointestinal parasites of sheep; however, comparatively little investigation has been made of the possible effect a similar regimen might have on the helminthiases of cattle. Recently, Foster[1] reviewed the literature dealing with this subject and, to obviate repetition, the reader is referred to that paper.

The following study was made to determine whether a program of free-choice administration of phenothiazine could control the level of parasitic infection of calves on a pasture grazed continuously.

Materials and Methods

The experiment was conducted from April 16, 1951 through April 13, 1953, on two adjoining 2.1-acre pastures furnishing forage consisting of dallis grass, carpet grass, and clovers. These pastures had been grazed by cattle intermittently from May 1950 to March 1951, at which time one calf from each pasture was killed for postmortem examination. Each calf was found to be harboring small numbers of *Haemonchus contortus, Ostertagia ostertagi, Trichostrongylus axei, Cooperia punctata, Nematodirus helvetianus,* and *Oesophagostomum radiatum,* indicating that the two pastures were comparably contaminated with these species.

Four grade Jersey steers, which had grazed another pasture where they had acquired natural parasitic infections, were divided into two pairs on the basis of age, weight, and fecal egg count. In an attempt to reduce further contamination, two steers were treated with 60 gm. phenothiazine each and placed on pasture A where they had access to a 1:9 phenothiazine-mineral mixture consisting of three parts each of salt, bonemeal, and crushed limestone, and one part phenothiazine, by weight. To serve as controls, the other two steers were placed, untreated, on pasture B where they had access to the same mixture, minus the phenothiazine. The mixes were kept in feed boxes placed near the watering troughs. Boxes were closed on three sides and covered for protection from the effects of wind and rain. The mixtures were broken up manually whenever excessive moisture caused clumping of the materials. The amount of mix consumed was recorded each time animals were placed on, or removed from, the pastures, whenever it became necessary to feed or to discontinue the feeding of supplements such as hay and grain, and whenever a sufficient amount had been consumed to require additional material. During one period extending from October 8, 1951 to December 3, 1951, the mixtures were replaced by a 1:9 phenothiazine-salt mixture on pasture A and by salt on pasture B. From July 14 to December 12, 1952, unmedicated mineral mixture was placed in the boxes on both pastures.

A total of 28 parasite-free grade Jersey calves from four to nine months of age were placed on the pastures by pairs at various intervals during the experiment. Calves were placed on, or removed from, the pastures so that from two to four pairs were on at all times. All animals were weighed weekly.

The course of infection of each calf was followed by fecal egg counts made every other day using the D.C.F. technic with zinc sulfate as the flotation solution. Due to morphological similarities, eggs of *H. contortus* and *O. radiatum* are grouped and recorded as "H"; those of *C. punctata, O. ostertagi* and *T. axei* are recorded as "C".

Seven pairs of calves were killed for postmortem examinations conducted in the manner described by Porter[2].

Discussion and Results

The phenothiazine-mineral mixture was available to the calves on pasture A for a total of 17 months. During this time, the calves consumed a total of 37 lb. of the mix for a daily consumption of 32 gm. At the same time, the controls on pasture B consumed a

†From The Regional Animal Disease Research Laboratory, Agricultural Research Service, U. S. Department of Agriculture, Auburn, Alabama.

total of 36 lb. of unmedicated mix for an average consumption of 31 gm., indicating that the calves exhibited no distaste for phenothiazine as incorporated in this formulation. During the two-month period when phenothiazine-salt mix was placed in pasture A, the calves averaged 12 gm. per day while the controls averaged 20 gm. of salt per day. This difference is significant and suggests that phenothiazine mixed with salt is not palatable to calves. When both groups had access to unmedicated mineral mix for a period of five months, the calves on pasture A averaged 24 gm. per day while the controls averaged 20 gm. per day. None of the animals exhibited any ill effects as a result of consumption of the mixes.

The rate of consumption of phenothiazine ranged from an average of 0 to 3 gm. (table 1) per head per day with, undoubtedly, some individual variation from calf to calf. The highest rate of consumption occurred during the spring and summer months; in the fall, when it became necessary to feed hay, the rate of consumption of the mixes (medicated and unmedicated) declined. With addition of a ground grain mixture to the diet during the winter months, the rate of consumption decreased until it was negligible. The salt content of the grain (1%) probably accounted for the cessation of mineral mix consumption. Fortunately, the period of greatest consumption coincided with the period normally most favorable for the acquisition and dissemination of cattle

TABLE 1. Data on Calves Having Access to Medicated (Phenothiazine) and Unmedicated Mineral Mixtures on Pasture

Dates On	Dates Off	Animal No.	Age (Mo.)	Consumed Head/Day (gm.)	Weight (lb.) On	Weight (lb.) Off	Weight (lb.) Gain	Eggs "H"† Max. e.p.g.	Eggs "H"† Days Passed	Eggs "C"†† Max. e.p.g.	Eggs "C"†† Days Passed
4/16	7/3/51	1187	17	0.8-3.0	485	610	125	102	78	388	78
		(1190)*	16½		355	465	110	108	78	434	78
4/16	7/16/51	1193	15	0.8-3.0	235	390	155	10	56	38	91
		(1194)	13		250	380	130	10	65	6	91
4/30	8/20/51	1211	8	1.6-3.0	235	390	155	42	57	424	112
		(1213)	8		250	380	130	260	112	770	112
7/16	10/11/51	1219	8	0.9-3.0	278	365	87	0	0	210	73
		(1216)	9		290	400	110	168	55	302	73
7/30	11/28/51	1217	8	0.5-3.0	310	383	73	10	84	202	105
		(1218)	9		290	365	75	120	105	404	105
8/20/51	5/5/52	1227	4	0.0-3.0	171	360	189	56	171	9200	241
		(1228)	4		179	320	141	518	234	670	241
10/11/51	6/30/52	1231	5½	0.0-3.0	193	420	227	58	231	4372	251
		(1226)	6		199	420	221	992	238	1756	247
12/7/51	1/30/52	1232	5	0.0-0.5	185	175	-10	0	0	1886	27
		(1233)	5		175	180	5	74	16	2600	27
2/4/52	4/8/52	1237	4½	0.8-1.0	210	245	35	54	21	2866	50
		(1236)	4½		205	225	20	258	20	2036	50
4/28/52	9/8/52	1250	6	1.0-2.7**	220	240	20	0	0	1412	123
		(1251)	6		215	300	85	108	112	1054	119
5/5/52	12/1/52	1242	8	1.0-2.7**	228	420	192	68	134	286	187
		(1248)	7½		235	355	120	306	159	1272	191
6/30/52	8/11/52	1235	10	0.0-2.7**	370	430	60	4	43	80	43
		(1240)	10		370	395	25	56	43	412	43
8/12/52	12/1/52	1261	4	0.0-0.0	200	230	30	106	83	1946	98
		(1264)	4		180	180	0	1650	87	8800	98
12/1/52	4/13/53	1270	4	0.0-1.0**	145	270	125	68	66	3800	83
		(1268)	4		145	215	70	220	66	1070	83
12/1/52	3/9/53	1271	6	0.0-0.4**	130	160	30	28	66	1088	83
		(1272)	6		140	200	60	152	66	1438	83
1/19/53	4/13/53	1281	4½	0.1-1.0	180	242	62	38	60	370	76
		(1282)	4		175	250	75	148	66	1304	83
			Average for treated		....	....	91	36	73	2038	123
			Average for controls		....	....	81	359	99	1706	123

*Unmedicated controls in parentheses.
**Unmedicated mineral mix fed from 7/14/52-12/12/52
†*H. contortus, O. radiatum*
††*C. punctata, O. ostertagi, T. axei*

parasites, while, conversely, the rate of consumption was lowest during the winter, which is normally the period presenting the greatest natural hazard to the development of these same parasites.

Fecal examinations of the four steers first placed on the pastures showed comparable, low egg counts of all species during their entire grazing period. As calves were added to the pastures, fecal examinations revealed that calves on pasture A were consistently passing fewer eggs of Haemonchus and the nodular worm than the controls on pasture B. During the winter months, when the consumption of the mixes was low, and during the five months when unmedicated mixtures were placed on both pastures, the "H" counts of the calves on pasture A rose slightly but continued to be lower than the rising counts registered by the controls during the same period. In addition, calves on pasture A passed "H" eggs an average of only 73 days while the controls averaged 99 days. At the time of maximum egg production (shown as maximum e.p.g. in table 1), the average "H" count for the controls was 359 e.p.g. while the treated calves averaged only 36 e.p.g., a 10:1 ratio. There was no consistent difference in the "C" counts, and at maximum egg production (table 1), the control calves averaged 1706 e.p.g. while the treated calves averaged 2038 e.p.g. On each pasture, the calves passed eggs of the small trichostrongyles an average of 123 days. Separate counts of *N. helvetianus* showed that the infections were slightly greater, though not significantly greater, in the calves on pasture A. All calves passed eggs of *Moniezia benedeni.*

Postmortem examination of seven pairs of calves confirmed the fecal egg counts. In table 2 are shown the kinds and numbers of helminths recovered. The control calves harbored an average of 623 *H. contortus* and 156 *O. radiatum* while the treated calves averaged only 41 and five, the differences in both species being significant at the 5% level. Examination of table 2 shows that, in one pair of calves, the control had no stomach worms and fewer nodular worms than the treated calf which, paradoxically, never had shown a positive "H" egg count. The answer to this apparent enigma is the fact that the specimens recovered from the treated calf were all adolescent, probably having been acquired during the last four weeks on pasture, at which time unmedicated mineral mix had been substituted for the medicated mineral mix on pasture A. On the other hand, the ileum, cecum, and colon of the control bore numerous nodules indicating that the calf had been infected with nodular worms and had perhaps undergone "self-cure." Though the control calves averaged twice as many *O. ostertagi* and *T. axei* as the treated calves, the differences are not statistically significant. Table 2 shows that an average of 1,346 immature specimens (unidentified as to species) were recovered from the abomasums of the controls against an average of only 40 in the treated calves. The difference is highly significant at the 5% level. As shown in table 2, there was little difference

TABLE 2. Numbers of Worms Recovered from Calves Receiving Medicated and Unmedicated Mineral Mixture on Pastures A and B

	Abomasum				Small Intestine			Large Intestine
Calf No.	*H. contortus*	*O. ostertagi*	*T. axei*	Immature worms*	*C. punctata*	*N. helvetianus*	Immature worms*	*O. radiatum*
1219	0	80	0	0	1760	0	0	0
(1216)	702	800	0	0	2000	600	0	6
1232	1**	720	0	0	3360	800	800	3**
(1233)	480	2080	0	2400	25800	1920	2400	270
1237	39	8320	0	160	28800	34400	8000	1
(1236)	1621	6960	0	3720	8000	800	800	28
1250	180**	2100	0	0	60000	0	0	9**
(1251)	0	2520	600	0	27000	0	0	4
1235	1	400	160	0	4000	0	0	8
(1240)	977	2560	0	1020	9600	4000	0	57
1261	72	120	0	60	3200	0	0	11
(1264)	160	2340	1200	300	51200	0	0	479
1271	0	1020	0	60	8000	1100	1000	2
(1272)	422	4920	0	1980	20000	2100	3000	251
Av	41	1823	86	40	15589	5549	1400	5
(Av)	623	3169	194	1346	20514	1346	886	156

Controls in parentheses.
*Unidentified as to species.
**Adolescent specimens.

between the two groups in numbers of *C. punctata, N. helvetianus* and immature specimens recovered from the small intestines, indicating that the regimen had little or no effect on these species.

The results of the experiment indicate that the level of parasitic infection of calves with the common stomach worm and the nodular worm was effectively controlled by the free-choice administration of phenothiazine even though the pasture was continuously grazed for two years. The difference in the numbers of *H. contortus* and *O. radiatum* that were recovered from the control and treated calves may have been due, in part, to a direct anthelmintic action of phenothiazine against the immature forms of the former species[3] and against the adult forms of both species as well as to a depressive action of phenothiazine on the rate of egg production and collateral ovicidal effect. The net result of this fourfold action of phenothiazine was an effective control of the level of contamination of the pasture with the free-living stages of these two pathogenic species. Since the overall objective is control of parasitism by controlling the parasitic contamination of the pasture, all animals should be treated with phenothiazine before being placed on the free-choice regimen.

There was no significant difference in the average weight gain; the controls averaging a gain of 81 lb. and the principals 91 lb. No doubt this can be explained by the fact that none of the infections reached a level that is commonly regarded as pathogenic. Despite the fact that animals are not clinically affected by low-level parasitism, the importance of constantly applying control methods should be stressed. Under certain conditions which are either directly favorable to the parasite such as warm, rainy weather, or conditions which are deterimental to the host, such as lowered nutrition, subclinical parasitism can blossom forth into pathogenic proportions.

Summary

An experiment covering a two-year period and involving 28 calves from four to nine months of age indicated that a regimen of free-choice administration of phenothiazine-mineral mixture effectively controlled the level of parasitic infection of the calves with *H. contortus* and *O. radiatum*. The program showed no significant effect on *O. ostertagi, T. axei, C. punctata* or *N. helvetianus*. The rate of consumption of phenothiazine ranged from 0 to 3 gm. per head per day with the highest rate of consumption occurring during the warm spring and summer months, while consumption was negligible during the winter, apparently as a direct result of the feeding of supplements such as hay and grain. A base of mineral mixture for the phenothiazine appeared to be preferable to one of salt.

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Bovine Hyperkeratosis

(Continued from page 101)

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During the last year or two we have read much, mostly in human medical journals, about the clinical value of isoniazid (isonicotinic acid hydrazine) in its action on *Mycobacterium tuberculosis* of both human and animal types. Most of these reports are, to say the least, encouraging about the arresting effect of isoniazid in the treatment of tuberculosis of man. Such research animals as rabbits and guinea pigs, when inoculated with virulent cultures of both human and bovine types and then treated with isoniazid, survived, though the controls died. However, in Great Britain, Rankin, of an Agricultural Research Council Field Station, failed to influence the course of three cattle showing clinical evidence — also positive bacteriological fecal smears — of infection with *Mycobacterium johnes*. Isoniazid did retard the growth of this organism *in vitro* but even here it was not found to be highly active.

Buffalo Gnats And Leucocytozoon Infections Of Poultry

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INSECTS long have been the plague of mankind. The smudge or smothered fire was probably one of man's earliest insecticides. Early American colonists, when insects became troublesome, often used a large smothered fire before their doors "as soon as the evening comes". Family cows were sometimes milked inside rings of such fire.

One of nature's most vicious insects is the small hump-back, black fly, also named the buffalo gnat or turkey gnat. Buffalo gnats have been found in all parts of the world, and over 75 species have been found in North America from Alaska to the Gulf of Mexico. These bloodthirsty insects dart at their victims in a swarm, attacking all species of livestock and man. Animals heavily invaded are left anemic. Numerous poisonous bites inflicted may result in toxemia and possibly death. One authority reports "bronchitis and pneumonia resulting from inhalation of large numbers of the insects."

Historical Background

Buffalo gnats have been destructive to larger forms of animal life in the Americas for many centuries. This small insect was reported specifically to have caused fatality among horses in Shelby County, Tennessee, as early as 1826. Homesteading operations in the South were impeded during the early part of the 19th century due to the devastating attacks of these insects upon the livestock. Chickens and turkeys were mentioned especially as victims.

After the levees of the Mississippi were built and kept in good repair, seasonal losses due to buffalo gnats in the Mississippi valley were reduced greatly. With the Civil War and disturbed economy throughout the nation, spring floods broke through unkept levees and the tiny black flies again became a destructive force to the livestock of the area and to the mules and horses of military encampments.

During the 1880's losses became particularly severe. In 1883, it was reported from Arkansas that buffalo gnats caused "fearful destruction" of horses and cattle and that it was "dangerous to drive stock through the bottom lands." In 1884, two counties in Mississippi experienced a loss of over 1,500 mules, to "exceed all previous records." It was about this time that an investigator was employed by the United States Department of Agriculture to report on "Simulium or Buffalo Gnats." It was found that every invasion of gnats was preceded by a rise in the Mississippi river sufficient to affect the streams, and that the "buffalo gnats, bull gnats, or turkey gnats", as they were called, not only were responsible for losses in horses, mules, and cattle but also were associated with losses in sheep, swine, and other small animals.

One species was named the "turkey gnat" because "it appeared at a time when turkeys are setting and suffer so much from them." Hogs were reported dying "in large numbers" soon after an attack and, also, later "from large ulcerating sores which caused blood poisoning." Many sheep crowded so close to smudge fires, built to protect them, "as to be burned to death." Poultry of all kinds were attacked; young fowl being killed ouright. Dogs and cats were tormented, and wild deer were reported losing their fear of mankind and "in their frantic endeavors for relief" would "lie down in the glowing embers" of a smoldering fire. The multiple bites of the buffalo gnats were considered generally to resemble the bite of a rattlesnake, and, during 1884, it was reported that "several persons were killed" by these insects.

In 1872, it was reported that the loss of horses in one county in Arkansas, due to buffalo gnats, exceeded the loss from all other diseases. In 1874, the loss of livestock in one county in southwestern Tennessee was estimated at $500,000.

Buffalo gnats have remained a destructive force into the 20th century. In 1927, geese were reported seriously attacked in Canada, and in 1928, heavy losses of chicks were reported from Iowa. In 1934, "dense swarms

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of buffalo gnats stopped spring farming in many parts of Arkansas . . . and killed thousands of dollars worth of livestock." An interesting report from Alabama in 1951 concerned a small flock of individually caged birds whose egg production declined sharply to a low level, due to black fly bites.

Leucocytozoon Infections of Poultry

During the past two decades, a small number of the many species of gnats have been incriminated as vectors of certain malaria-like protozoan blood parasites known as the leucocytozoa. Over 50 different species have been catalogued, all occurring in various birds in all parts of the world. Infections due to these protozoan parasites result in anemia, toxemia and death of some victims.

In the United States *Leucocytozoon simondi* has been reported from various parts of the country as being destructive to young domestic and wild ducks, *L. bonasae* reported from Canada as being destructive to grouse, and *L. smithi* destructive to turkeys. In 1951, Atchley, working in South Carolina, observed in domestic chickens what appears to be a new species of leucocytozoon, which he named *L. andrewsi.* While Leucocytozoon infection of chickens had been reported from certain Asiatic countries, the observation of this parasite in South Carolina, Atchley indicated, appeared to be the first such report in the Western Hemisphere. It has not been determined yet how the infection, in chickens, in the United States is spread, or even if the infection is of any pathogenic significance.

Leucocytozoon smithi Infection of Turkeys

This parasite, first observed by Theobald Smith in 1895, appears to be the most destructive Leucocytozoon of domestic poultry in North America. Losses in turkeys, due to this parasite, have been reported from various parts of the nation. Owners of turkey flocks refer to the disease as turkey malaria, gnat fever, and gnat disease.

Of a number of investigators, Johnson, who studied the disease in Virginia, has made particularly significant contributions. Earlier investigators believed the Leucocytozoon had invaded a leukocyte and others an erythrocyte. One of Johnson's conclusions was that *L. smithi,* as observed in a blood smear, was in the blood plasma and not within the host cells. He also demonstrated that it was necessary for the parasite to develop in the stomach of the black fly (Johnson incriminated *S. nigroparvum*) in order to become infectious for turkeys. Johnson further revealed, by daily study of blood smears from artificially infected turkeys, that *L. smithi* (gametocytes) first appeared in the peripheral blood nine to 13 days after the turkey had been bitten, and that the parasites, while gradually disappearing, remained in the blood for as long as five to six months.

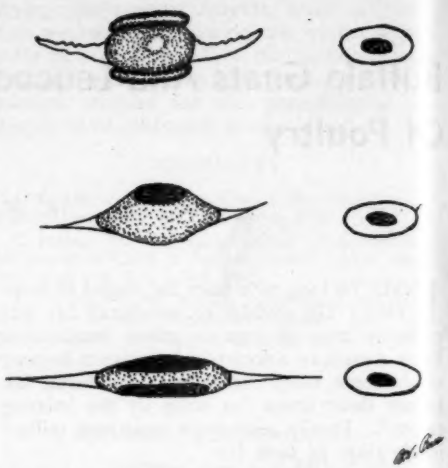

Fig. 1. Leucocytozoon smithi. Some ordinary blood forms, shown with normal turkey red blood cells (right) drawn to scale. The tails may be visible only under reduced light.

The turkey serves as a host and as a source of food for the Leucocytozoon, and also as a source of food for the buffalo gnat. The buffalo gnat, also parasitized, in turn serves as a source of food for the Leucocytozoon. This genus, the lowest form of life involved, gives nothing and gets all; the black fly gets something; and the turkey gets only misery, disease, and possible death.

L. smithi in Southeastern United States

In the southeastern United States, the indications are that Leucocytozoon infection of turkeys is, for the most part, a disease of the Tidewater area that exists mainly in the subtropical zone of the eastern seaboard, and, as the season progresses, extends inland as far as the "fall line belt" and somewhat beyond. A large percentage of all turkeys in this area appear to become infected, to some degree, at some time during the life of the birds. The infection may or may not be of clinical significance. It has been the writers observation that the disease appears suddenly in the spring, disappears in the summer after the season becomes hot and dry, and recurs during the late

summer or early fall. In the fall the birds are large, nearing market age, and are more resistant to infection. Consequently, the disease assumes a different character at this season than the outbreaks which occur earlier. The earlier outbreaks are usually flock conditions and losses may be severe. Later outbreaks seldom are observed to be flock conditions, mortality is usually low, and heavily infected birds die suddenly. The owner usually reports, in later outbreaks, that he has had difficulty finding a live, sick bird for laboratory examination, but that he finds several birds dead under the roost every morning. Fowl cholera appears to be associated rather frequently with these later outbreaks. One authority reported that heavy losses of turkey poults occurred in a certain area in Virginia in 1933 and 1934 during the months of July and August, and that heavy losses also occurred, in a larger area during 1935, presumably during the same months. The disease, for the most part, is

Fig. 2. All spleens pictured illustrate gross enlargement. All are from 12-week-old turkey hens from the same flock. Losses were occurring from acute Leucocytozoon infection. The outbreak occurred in the fall of the year after the first killing frost of the season (November). The spleen remains chronically enlarged, which lesion is important from a diagnostic viewpoint.

associated with balmy weather. In the field, Leucocytozoon infection usually resembles fowl typhoid because of the gross enlargment of the liver and spleen. As already indicated, losses may be sudden and severe or may be rather sporadic and, while usually confined to birds on range, poults in unscreened brooder houses may be affected.

There is no specific treatment for Leucocytozoon infection. Sulfonamides as flock treatment and antibiotics for individual treatment have been reported as helpful. The action of these drugs appears to be of an alterative nature. There have been no carefully controlled experiments to evaluate these reports. Large birds, if treated in time with a large dose of penicillin intramuscularly, appear to respond miraculously. Birds raised in confinement, as conclusively demonstrated by Johnson, sheltered from insects by fine-mesh screen or cheese cloth, are protected from this and many other diseases.

Fowl cholera of turkeys appears to be far more prevalent in turkey flocks affected with *L. smithi,* especially during outbreaks occurring late in the season, indicating that the species of Simulium responsible for the transmission of Leucocytozoon infection in turkeys also may be responsible, in some instances, for the transmission of fowl cholera bacillus.

Control of Leucocytozoon Infection

There are three alternatives having to do with the control of Leucocytozoon infection in turkeys:

1. The present practice is to turn birds out to the mercy of the insects and, by good care and a well balanced diet, endeavor to maintain them in a good state of health. Clinical evidence of this or other diseases is usually promptly treated by a rational use of the antibiotics and/or sulfonamides and food supplements. Many growers carry on profitable operations in this manner even though their flocks are visited annually by Leucocytozoon. The amount of profit, however, is reduced by resulting mortality and reduced gains.

Good health is enhanced by keeping flocks on relatively clean ground, by keeping the size of the flock within limits that permit of good care, by feeding a supplement containing vitamin A when pasture is dry or inadequate, and by controlling internal parasites.

2. It was demonstrated 15 years ago that confinement rearing with fine-mesh screening is a positive means of control not only of Leucocytozoon but certain other diseases. This method of raising turkeys, especially the so-called broiler size bird, is gaining in favor. Expensive buildings, however, are necessary. In the warm, deep South, turkeys can be raised with a minimum of buildings and expense by utilizing range and field crops. While poults are raised in brooder houses, fine-meshed screening or other protection from insects is usually disregarded as a potent and positive method of disease control. Poults that develop Leucocytozoon infection in the brooder house become infected because of inadequate pro-

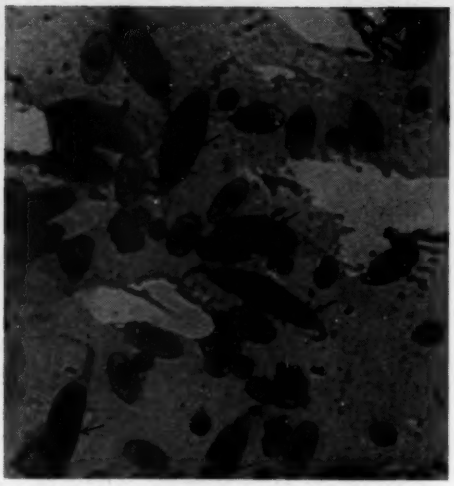

Fig. 3. Photomicrograph of blood smear. Leucocytozoa indicated by arrows. (X 450). Photomicro-

graphs of blood smears made from the same turkey hens that supplied spleens illustrated in figure 2. Giemsa's spirochete stain, diluted with approximately ten parts water, and allowed to stain for 30-45 minutes, after the slide has been air dried and fixed with absolute methyl alcohol, is excellent for critical examination. The parasites are easily observed under low power with a No. 10 eye piece. The experienced worker can find the parasites by examining a little fresh blood placed on a glass slide, diluted with saline solution, and covered with a glass cover slip, thus obviating the necessity of preparing a smear and staining. Tails outlined by dotted line. (X1,000).

tection against black flies. Thus, infection of housed birds can be positively controlled. This much of the problem has long been solved. It is a matter of simple management.

3. Leucocytozoon infection in range turkeys can be controlled by directly or indirectly checking the transmission of the blood parasite. This, as the saying goes, is a lot easier said than done. The disease is perpetuated by carrier adult turkeys which serve as a source of infection to certain species of black flies, and, the Leucocytozoon-infected black flies, in turn, infect other turkeys. Consequently, elimination or a reduction in the number of carriers would offer some relief. Seasonal operations should be helpful in this respect. Unfortunately, the numerous small flocks of wild turkeys (assuming they are infected), in the heavily vegetated areas of southeastern United States, may ever pose a threat to a carrier elimination program. If the carriers could be eliminated, the vicious, blood-sucking black fly would still attack its victims and continue to take an annual toll. Thus the problem of controlling black flies is actually part of a greater problem of controlling insects that annoy poultry. Mites and other insects, by their annoyance, blood-sucking and other activities, can interfere seriously with gains in weight and quality. Mosquitoes may spread fowl pox, and the common house fly may spread fowl cholera. It thus appears that insect control of poultry may not only control Leucocytozoon but may have extensive disease control potentialities that may eventually be utilized as a profitable endeavor.

Control by attempted eradication of the black fly larvae is extremely difficult because the fly prefers flowing rather than stagnant water as a breeding place. Certain insecticides will destroy the black fly larvae but the dosage must be controlled so that other forms of aquatic life will not be injured. DDT fogs from the air have been reported as being useful as a means of controlling the adult fly. While insecticide repellants have not, as yet, been successful, some individual turkey growers report a method of successful control of the adult fly by dusting ranges and birds with cotton dust. For several years one grower in particular has been dusting his turkey range every time he dusts his cotton. He has followed this procedure since finding that an accidental application of insecticide from the air, appeared to be harmless to the birds. Reports of this kind, of course, must be evaluated scientifically before conclusions as to merit can be made.

(Continued on page 115)

Studies Of The Hog Cholera Virus II. The Effect Of Nitrogen Mustard On Pathogenicity†

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TENBROECK and Herriot[2] reported that the hog cholera virus was inactivated by the mustard, bis (*B*-chloroethyl) sulfide. These workers inoculated 23 pigs with the hog cholera virus in the form of sera and organ suspensions that had been treated with the mustard. Two of the pigs died from causes other than hog cholera and three died from the disease, following pen exposure to sick pigs. The remaining 18 showed some immunity, but all developed some symptoms of hog cholera. Johnson[3] obtained evidence of a lethal effect of nitrogen mustards on the fowl leucosis virus. Blood drawn from treated birds failed to transmit the disease to susceptible birds. These reports prompted the studies that form the basis of this paper.

Materials and Methods

Virus. A commercial strain of the hog cholera virus was used as the stock virus. Two ml. of the stock virus were injected into a susceptible pig, designated as virus pig. When the febrile response of the pig appeared to have reached its peak, a citrated blood sample, designated as blood virus, was taken aseptically, or the pig was sacrificed and the spleen removed under aseptic conditions. The preparation of a spleen suspension, designated as spleen virus, was done according to the procedure described elsewhere[1]. Exposure of the blood virus or spleen virus to nitrogen mustard was accomplished by adding 5 ml. of the virus to a dry, sterile vial containing 10 mg. of the nitrogen mustard. The vial was shaken for 30 minutes, and the 5 ml. of the mustard-treated blood or spleen virus were injected intramuscularly into a susceptible pig at the end of a second 30-minute period. One group of pigs was injected with the mustard-treated spleen virus 24 hours after its preparation. Two groups of pigs were injected with the mustard-treated spleen virus prepared in multiple-dose lots. Control pigs were used to determine the pathogenicity of non-treated portions of the blood or spleen virus and the possible spread of infection from the pigs injected with the mustard-treated blood or spleen virus. Daily observations were made for the development of symptoms, and autopsies were performed whenever indicated. Pigs that survived the injection of the mustard-treated blood or spleen virus were challenged three to four weeks after the injection. Susceptible pigs were used to determine the pathogenicity of the challenge virus.

Pigs. The source and the method of handling the pigs has been described elsewhere[1].

Nitrogen Mustard. The nitrogen used, obtained through the courtesy of Dr. E. P. Johnson, Va. Agric. Exp. Sta., was methyl-bis (*B*-chloroethyl) amine.

Results and Discussion

A lot of mustard-treated blood virus was prepared from each of two virus pigs. The pigs that were injected with 5 ml. each of the mustard-treated blood virus prepared from one virus pig did not develop symptoms as a result of the injection. They were found to be susceptible when challenged three to four weeks later by an intramuscular injection of virulent virus. Four pigs that received the mustard-treated blood virus prepared from the second virus pig developed typical hog cholera symptoms and lesions following the injections. All control pigs developed typical symptoms and lesions. It is evident that the effect of the nitrogen mustard on the hog cholera virus, in the form of blood virus, was inconsistent under the conditions of the study. It is possible, however, that, if a blood virus were standardized to a constant virus content, predictable results might be obtained.

Twenty-four pigs were injected with 5 ml. each of mustard-treated spleen virus that had been prepared in single-dose lots. None of these pigs developed visible symptoms of hog cholera. Seven of the 24 pigs developed a rise in temperature following the injections. Six of these seven pigs showed the temperature rise on the 12th day, or later, following the injection of the mustard-treated spleen virus. Four

†Adapted, in part, from a thesis submitted to the Virginia Polytechnic Institute in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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of these died with complications apparently arising from liver damage caused by ascarids and verminous pneumonia. It is likely that the febrile response in these pigs was due to secondary factors rather than to the injection of the mustard-treated spleen virus. Two additional pigs of the same group also were lost from the same complicating factors, although they showed no febrile response. Sixteen of the 24 pigs were challenged at the end of three to four weeks by an intramuscular injection of virulent virus. All were immune to the challenge and showed no visible response to the virulent virus. The data indicate that the pathogenicity of the hog cholera virus was considerably lessened and that the antigenic potency of the mustard-treated virus was still sufficient to produce a high degree of resistance to severe challenge.

Three pigs that were injected with mustard-treated spleen virus 24 hours after it had been prepared exhibited no evidence of response to the inoculation. All three were immune to virulent hog cholera virus injected intramuscularly three to four weeks later. Although the data is completely inadequate, these results suggest that the treatment of the virus with the nitrogen mustard could be carried out considerably in advance of its use.

Three groups, totaling 19 pigs, were injected with mustard-treated spleen virus prepared separately from each of three virus pigs; each group was exposed by pen contact three to four weeks later. The first group, five pigs, showed no febrile response or visible symptoms of hog cholera after the injections, and were immune when challenged by pen exposure three to four weeks later. The second group, consisting of eight pigs, also showed no reaction to the injections, but all developed hog cholera when exposed by pen contact with sick pigs. The spleen virus prepared from the virus pig used for the second group was apparently of low potency, for the two pigs used as a check on its virulence developed only mild symptoms, from which they rapidly recovered. The virus pig itself had developed a febrile response of only two days duration. It is apparent from the results obtained that, if the potency of the virus suspension is low, the pathogenicity as well as the immunizing potential of the virus may be destroyed by treatment with the nitrogen mustard. Three of the six pigs in the third group developed a slight temporary febrile response to the injection of the mustard-treated spleen virus. All six were immune when challenged by pen exposure to sick pigs.

Ten pigs were injected with 5 ml. each of mustard-treated spleen virus prepared in multiple-dose lots. Two of the ten developed temporary slight rises in temperature following the injection. All were immune to challenge by pen exposure to sick pigs three to four weeks later.

Susceptible pigs in contact with various groups of pigs injected with the mustard-treated spleen virus failed to develop the disease. These susceptible pigs, in every case, succumbed when given virulent virus at a later time.

Summary

The hog cholera virus in the form of blood virus was treated with the nitrogen mustard, methyl-bis (*B*-chloroethyl)amine, in the proportion of 5 ml. of blood virus to 10 mg. of nitrogen mustard. In one lot of blood virus so treated, the pathogenicity and immunizing potency of the virus was destroyed, whereas in a second lot the virulence was not reduced and the injected pigs developed hog cholera.

Treatment of 5 ml. of the virus, in the form of spleen suspension, with 10 mg. of the nitrogen mustard reduced the virulence of the virus so that no severe ill-effects were produced in pigs injected with the mustard-treated spleen virus. When spleen virus of high potency was treated with the nitrogen mustards, the resulting mustard-treated spleen virus produced a satisfactory immunity in pigs to challenge either by the intramuscular injection of virulent virus or pen exposure to pigs sick with hog cholera.

Susceptible pigs in contact with pigs receiving the mustard-treated spleen virus did not develop hog cholera.

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A striking inherited physiological pecularity is found in the Dalmatian. This breed is less able to break uric acid into allantoin than are other breeds, and consequently larger amount of uric acid are excreted in the urine.

Dalmatians also have fewer intranuclear crystals in their liver cells than have other breeds of dogs. This is also inherited and appears to be associated with high uric acid secretion.—*The Genetics of the Dog.*

Veterinary Medicine In Sweden

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SWEDEN lies in the same degree of latitude as Alaska, Greenland, and Siberia, however, the warm waters of the Gulf Stream afford Sweden a comparatively mild climate despite its northerly position. The population is about 7,000,000, most of whom live in the southern part. Only one-tenth of the country is in cultivation, the remainder being forests and mountains. Fortunately Sweden is able, through its efficient agricultural practices, to be almost self-supporting. Sweden is 1,000 miles in length, and the farming conditions are diverse. The southern area is the most fertile farming region, with a diversified agriculture including grains, oil plants, sugar beets, and grass. Central Sweden consists of fertile plains with large areas of rolling forest lands which support a highly developed dairy industry. Most farms include profitable forest lands. In northern Sweden, the area north of Stockholm, farming consists mainly of fodder crop production and dairy farming. Forestry also is combined with farming in this region.

Animal Populations

In 1949, there were 2,600,000 cattle, 1,200,000 hogs, 465,000 horses, 300,000 sheep, and 1,200,000 fowls in Sweden. Farm mechanization is replacing rapidly the horse all through northern Europe.

Veterinary Administration

There are more than 700 veterinary surgeons in Sweden. The right to practice is acquired by the veterinary surgeon's examination and authorization by the Royal Veterinary Board, which is the central government office for veterinary administration. This Board is responsible for the supervision of the general health and care of domestic animals, the production and quality of animal food products, as well as other veterinary matters. The Veterinary Board provides assistance to the states and cities as well as to other government agencies. It keeps the official register of veterinary surgeons and provides printed lists for the guidance of pharmaceutical chemists in regard to the prescription of drugs.

There are four departments, *viz.*, General, Hygiene, Tuberculosis, and Administration. The General Department deals with matters concerning veterinary practice, the division of the country into veterinary districts, civil veterinary and military surgeon appointments, state of health and treatment of animals, the importation of live animals, quarantine, and the keeping of the register of veterinary surgeons.

The Hygiene Department, the head of which is the State Inspector of Meat Control, deals with matters concerning town public health veterinarians and veterinary inspectors, meat inspection, importation and exportation of meat, and milk hygiene.

The Tuberculosis Department's field activity covers those diseases of domestic animals which are under some type of control program. The control program is in cooperation with the Rural Economy Association. These diseases are tuberculosis, brucellosis, infectious mastitis, Salmonella infection in poultry, and certain swine diseases. This department also assigns veterinarians to these activities.

The Administrative Department is responsible for organization, personnel, and finances, as well as the statutory and legal questions.

Veterinary services are provided the country through various arrangements between the Veterinary Board, the local government or agriculture associations, and the veterinary surgeon. The following summarizes briefly the various positions, numbers and responsibilities:

1. Country veterinarians (25) are mainly supervisory and consultative. Their income is from a state salary and from private practice fees.

2. District veterinary surgeons (282) are responsible for disease control, providing veterinary medical services, and issuing official certificates. They also are empowered to enforce the food hygiene law. Their income is derived, in part, from a state salary and the remainder from official fees.

3. Extra veterinary surgeons (8) are appointed for special tasks such as controlling epizootics or regional testing programs. They are paid by the state and local areas. There

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is another group (12) which is called veterinary bursary holders and which is equivalent to being paid a retainer. They usually relieve or assist veterinarians who have permanent appointments when they are on leave or need extra help.

4. The veterinary hygiene, or public health services, are provided by the municipal veterinary surgeons. They are appointed by the Veterinary Board at the request of the municipal government. They are usually independent of the municipal board of health, answering directly to the municipal council. They are responsible for all food hygiene, animal disease control, and other veterinary activities in the town or city. Twenty-two towns have municipal or public health veterinarians. In Stockholm, there are three such positions; in addition, the Stockholm Health Department employs two more veterinarians for food hygiene supervision. Gothenburg has two city veterinarians.

5. Meat inspection at public slaughter houses is conducted by veterinary meat inspectors appointed by the Veterinary Board after consultation with local board of health or slaughter house authorities. There are 14 such posts. In addition, there are more than 150 part-time meat inspection posts in municipalities which are filled by veterinarians appointed by the Veterinary Board. Veterinary surgeons also are appointed by the Board to positions at 74 slaughter houses owned by agricultural cooperative associations. These are full-time positions and some of the large plants have two inspectors.

6. Quarantine and import and export veterinary inspectors are usually part-time positions, and are filled by appointment of municipal or other veterinary surgeons in the region.

7. The Rural Economy Associations maintain their own veterinary services to combat tuberculosis, brucellosis, fowl typhoid, and other Salmonella infections, and swine diseases. There are 20 veterinarians in ten different associations. Their appointments also are made by the Board.

8. Artificial insemination is under control of the Veterinary Board. The artificial insemination work is carried out by a system of agriculture organizations. There are about 40 authorized veterinarians and about 50 foreign veterinarians employed by the artificial insemination association who came to Sweden as war refugees and have been trained at the Royal Veterinary College for this work.

The function of the Military Veterinary Service is to supervise the health of army animals, the remount service and supply horses for the army, and inspect animal foodstuffs. The chief Army veterinarian is directly responsible to the Commander in Chief of the Swedish Army. The Army Veterinary Corps consists of regular and various classes of reserve officers. Every Swedish veterinary surgeon can be called on for military service up to the age of 47, and is required to serve in the army for a statutory time.

Animal Disease Control

Sweden is in the favorable position of being relatively free from infectious animal diseases. This can be attributed to its geographical position and quarantine regulations and enforcement, particularly at the borders.

The quarantine regulations source or frontier watch were established in 1898. The principle of these legislative measures is that, when a disease occurs abroad, no animals or animal products may be imported from the affected country or region. Importation from known diseased regions is either forbidden or allowed only under special circumstances. Rinderpest, foot and mouth disease, swine fever, fowl pest, and rabies are subject to the most stringent restrictions. Of these diseases rinderpest has not been reported since the 18th century. Rabies has not occurred since 1871.

The most important zoonoses have been bovine tuberculosis and brucellosis. The control campaign for both these diseases has received state support for many years. The tuberculosis campaign was inaugurated in 1897. The present regulations, effective in 1942, are part compulsory and voluntary. The tuberculin testing is carried on by the state, and the farmer pays the travel cost of the veterinary surgeon. If reactors are found, they must be branded and sent to slaughter within 15 days. If the udder or genitalia is infected, they must be slaughtered within eight days. If more than three-fourths of the animals over two years of age are reactors, all the animals over two years of age must be marked. The Rural Economy Association also carries on a continuous clinical control program. This was important 15 years ago but, as the disease has disappeared, it is of less value. In 1938, there were 15,000 herds under clinical tuberculosis control, in 1951 there were only 450. An extra control measure is that all milk intended for animal feeding must be pasteurized. All cases of tuberculosis found on meat inspection are thoroughly investigated.

The Swedish authorities attribute their rapid progress to the state regulations which require

higher payment for milk from tuberculosis-free cows. In addition there has been reductions for milk from animals which were not under the program.

The national government also provides a subsidy to small farmers for buying new animals, provided they sign up with the national program. This may be as high as 500 kronor (about $97.).

As of October 1, 1952, 15 counties were tuberculosis-free, seven were tuberculosis protected (modified free areas) and one partially free. Only one county was still on a voluntary basis. Dr. Hans Bengston, director of the tuberculosis control program stated that there were only about 250 herds of 270,000 with reactors. Most of these reactors were due to non-specific reasons such as acid-fast organisms that have not been identified or *Mycobacterium tuberculosis* of avian or human origin. Avian tuberculosis is not a problem but human infection is still prevalent in Sweden. Doctor Bengston believes that most of the herds, except those in one county, will be liquidated in 1954.

The present brucellosis control program was inaugurated in 1938 and revised in 1943. The campaign is partly compulsory and voluntary. In brucellosis-free areas, infected animals are slaughtered and indemnity paid. It is obligatory to report abortions. Control is maintained by means of pooled milk sampling. Participation in the program is by the entire membership of dairy associations or societies who join collectively. Rarely does an individual participate. In the case of acutely infected herds, vaccination with strain 19 has been used in calves 4-8 months of age. Now that the disease is no longer widespread and reactors can be caused by vaccination, vaccination is not used except under rare circumstances.

The campaign against brucellosis has exceeded any expectation of the organizers. In 1944, about 6% of the herds were infected. By 1948, this had fallen to 3.5%. On January 1, 1952 only 0.3% were infected. On October 1, 1952, 17 counties and part of one were free, two brucellosis protected (modified accredited areas), and four counties were on a voluntary program. Doctor Jensen stated that by the end of 1953 all of the remaining reactors (200) herds will be slaughtered.

The assistance given by the state subsidies, higher milk prices and dairy association indemnities have resulted in a very successful program.

Fowl salmonellosis or pullorum disease control has been another active state campaign. This covers most of the 1200 poultry breeding farms of which 765 are declared free of disease.

The Veterinary Association of Sweden was founded in 1860 and functions as an organization for the protection of the interest, and to promote the development, of the veterinary arts and science.

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Buffalo Gnats and Leucocytozoon Infection of Poultry

(Continued from page 110)

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PUBLIC HEALTH

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Rapid Test for Human Brucellosis

The development of a rapid test for human brucellosis has been an objective of many investigators. Dr. M. Ruiz Castaneda of Mexico City, one of the outstanding world authorities on this disease, has recently developed new technics which he is using in his laboratory and which he reports in the Bulletin of the World Health Organization*. In this article, he discusses the surface-fixation test, spot test, and skin test, as rapid means of diagnosis. A careful comparison of the results of these tests with those of blood culture and tube agglutination tests demonstrates that the spot and surface-fixation tests gave positive reactions in all proved cases of human brucellosis. The skin test reactions he used, however, were only positive in about 50% during the first three months of disease, rising to about 90% positive in the sixth months. The author concludes from his studies that the use of the three rapid tests will reveal more suspected human cases than either the blood culture or the tube agglutination test.

The spot test is performed with whole blood which can be taken directly from the finger tip or ear lobe. This is placed on a slide and mixed with an antigen. Within a minute, if any antibiotics are present, a ring of blue antigen will become apparent at the edge of the circle which surrounds a reddish center resulting from the separation of red cells from the agglutinated antigen.

The surface-fixation test is a chromatographic procedure, in which the antigen is printed in dots on a piece of filter paper. When serum is placed over the dots, and a current of saline allowed to cover the paper by capillary absorption, the results of the reaction are developed. The spot of the negative control will be washed out, leaving a trail of antigen; in the positive control, the spot remains fixed. The unknown is interpreted by comparison with the control. The test takes about 30 minutes to run. Castaneda uses a soluble extract of Brucellae for his skin test and states that it is quite satisfactory for the detection of skin sensitivity in brucellosis. The author points out that when suspected cases are encountered they should be referred to specialized laboratories for confirmatory tests.

Castaneda has previously pointed out that brucellosis may never be controlled in some areas of the world and will remain a constant public health problem in those areas. This point of view is also shared by other public health officials as well as agricultural authorities who point out that it is economically impossible to control and eradicate the disease in Latin America and in the Mediterranean countries. From a world point of view, brucellosis is one of the major unsolved communicable disease problems of man and animals.

Bul. World Hlth. Org., 9:399, 1953.

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Psittacosis

The National Office of Vital Statistics reports that, of 48 cases of human psittacosis on which epidemiological information was received in 1953, one-fourth of the cases occurred in persons either operating or employed in aviaries or pet shops. The aviaries include those classed as private. Epidemiologic data were also received on 8 cases which occurred among employees of a poultry processing plant. The source of infection for the 12 remaining cases was not ascertained. It is interesting to note that about 40% of human psittacosis on which epidemiologic reports were received fell in the category of occupational disease.

In 1952, information was received from 12 states on 70 cases of psittacosis. Of these, 29 occurred among employees of a poultry packing plant in which turkeys were suspected as the source of infection. Parakeets and turkeys were incriminated as the sources of most human infections but in addition, canaries, pigeons, and chickens were presumed to be sources of infection.

Many aviaries and bird breeders are interested in eliminating disease from their flocks. To do this they need assistance and will be turning to practicing veterinarians for this help. It behooves veterinary practitioners to be familiar with all aspects of this problem.

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Farm economists forecast a larger spring pig crop; an increase of approximately 4% over 1953.

A Preliminary Study On The Effectiveness Of Hexylresorcinol Suspension As An Enema In Removing Hookworms, and Whipworms From Dogs†

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HEXYLRESORCINOL is a relatively nontoxic, poorly absorbed drug. It exerts a caustic action on the tissues of worms, upon contact. The mucin of the bowel protects the intestinal epithelium by combining with the drug and neutralizing its action. Leonard[1] demonstrated that the bactericidal action of resorcinol is increased by the addition of the alkyl chain and reaches maximum activity with a six straight-chain group (N-hexylresorcinol). Hexylresorcinol is quite soluble in an olive oil and glycerin base, and Brown[2] observed that the preparation acted upon the adult ascarid slowly. However, the aqueous suspensions killed the parasite rapidly.

The therapeutic value of hexylresorcinol in the removal of ascarids and hookworms from man and dogs has been established for a number of years. Lamson *et al.*[3] found that single therapeutic doses, given orally, removed practically 100% of the ascarids from dogs and 90% or more from man. These workers also found hexylresorcinol to be effective against the dog hookworm, *Ancylostoma caninum*. Subsequent work by other investigators is in general agreement with these reported findings.

A number of workers (Basnuevo *et al.*[4], Basnuevo *et al.*[5], and Jung and Beaver[6]) recently have reported a technic involving the use of hexylresorcinol aqueous suspension as an enema in the effective removal of the whipworm (*Trichocephalus trichiurus*) from children. This technic was evolved in an effort to bring the therapeutic solution in direct contact with the parasites in the cecum, colon, and rectum. Basnuevo *et al.*[5] reported successful treatment of trichocephaliasis in man by using approximately 15 ml. per lb. body weight of a 1:300 dilution. Jung and Beaver[6] had satisfactory results in treating uncomplicated cases of trichocephaliasis with 250 ml. of a 0.2% suspension; results with the use of higher dilutions were not generally satisfactory.

This study was initiated in an effort to determine if hexylresorcinol suspension, as an enema, would be effective in the removal of whipworms from the dog. During the early phases of the work, the incidental observations regarding the effect on ascarids and hookworms indicated that the study should be broadened to include these parasites.

Materials and Methods

Seventy dogs, all of which were naturally infected, were used in this study. Twenty-five of these were classified as puppies and the other

†Approved by Committee on Publications, School of Veterinary Medicine, Alabama Polytechnic Institute. Publication No 329. This study was supported in part through a grant from Sharp & Dohme, Inc., Philadelphia, Pa.
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45 as adults. The type and relative degree of pretreatment infections was determined by egg-per-gram counts made daily for an average of five days. A modification of the Lane centrifuge method[7] was employed for samples having up to 200 eggs-per-gram, and a modification of the Stoll dilution method[8] was used for higher counts.

Twenty-six dogs harbored single infections of the parasites, while 25 harbored hookworms and roundworms, 16 harbored hookworms and whipworms, and three hookworms, roundworms, and whipworms. For purposes of evaluation, each type of infection was considered as an individual case. The total number of infections were as follows: hookworms, 65; roundworms, 29; whipworms, 18.

The extremes in egg-per-gram counts were as follows: Hookworms, 1,500 to 95,000; roundworms, 100 to 143,000; whipworms, 50 to 3,600. Post-treatment counts were made for an average of three consecutive days to determine, to some degree, the effectiveness of the treatment, either in destroying the parasite or suppressing egg production. Fifteen dogs were processed by this method alone, arbitrarily using a criterion of a drop to five eggs per gram feces or less as a satisfactory treatment. Subsequent critical examinations were made on 55 dogs by destroying them and examining the intestinal mucosa. An arbitrary standard of five parasites or less, demonstrated at necropsy, was considered satisfactory. Representative sections were taken from selected animals for histopathological examination to determine if pathological alterations had resulted from treatment.

Materials used for treatment were a 1-liter gravity-flow irrigation bottle with four feet of rubber tubing and two detachable hard-rubber nozzles, one 6 in. long and ⅜ in. in diameter for large dogs and one 3 in. long and 3/16 in. in diameter for puppies and small dogs. A rubber bulb fitted to the air intake of the bottle was of definite aid in obtaining optimum pressure, which varied from animal to animal.

Treatment

1. A suspension of the desired strength was prepared by adding especially prepared hexylresorcinol tablets** to tap water. Tablets containing 0.4 gm. and 0.5 gm. hexylresorcinol were used, and a corresponding percentage solution (0.4%, 0.5%) was prepared by adding one of the above tablets to 100 ml. tap water. A 0.2% solution was prepared by adding one 0.4 gm. hexylresorcinol tablet to 200 ml. tap water.

2. The animal was prepared for treatment by following one of four selected methods:

TABLE I. Composite Results of Treatment as Determined by Necropsy Worm Counts* and Egg-per-gram Counts**

	Hexylres. Dil. (%)	No. Dogs Treated	Effective	Total % Effective
A. Hookworm	0.2	6	5	83
	0.4	16	14	87
	0.5	36	23	64
	1.0	3	1	33
	2.0	4	2	50
Total		65	45	70
B. Roundworm				
	0.2	3	2	66
	0.4	9	8	88
	0.5	17	9	53
	1.0	—	—	—
	2.0	—	—	—
Total		29	19	65
C. Whipworm				
	0.2	5	2	40
	0.4	6	3	50
	0.5	6	3	50
	1.0	1	1	100
	2.0	—	—	—
Total		18	9	50

*Presence of no more than five worms considered effective.

**Egg-per-gram counts of five or less considered effective.

(a) A pretreatment enema of tap water to evacuate the bowel was given five to ten minutes before administration of the therapeutic suspension, or (b) the animal was fasted for 24 hours prior to treatment, or (c) the animal was treated without fasting or a pretreatment enema, or (d) the animal was given a purge 12 hours prior to treatment.

3. Treatment was accomplished by gently inserting the appropriate rubber nozzle (considering the size of the subject) up to the first curvature of the colon and allowing the suspension to run in by gravity flow. Gentle pressure from occasional use of the attached rubber bulb was helpful in some cases.

4. The amount of suspension was determined by the body weight of each animal; an approximate average of 15 ml. per lb. body weight was used. This accomplished a "through-and-through" enema in a number of cases, as evidenced by vomition.

5. The suspension was allowed to drain of its own accord.

6. Food was withheld for six to eight hours post-treatment.

**Supplied through courtesy of Sharp & Dohme, Inc., Philadelphia, Pa.

Results

A number of factors determined the overall results obtained from this study, *i.e.* method of administration, dilution of the therapeutic suspension, physical condition of the animal, and degree of infection. No attempt has been made here to include results as established by each of the above factors, with the exception of the dilution factor of the therapeutic suspension. The necessary data regarding effectiveness of treatment and manner in which that information was obtained is included in tables I and II. Other factors are dealt with under discussion.

Pathology

Among the cases observed in this study, 11 of 55 (20%) showed some degree of enteritis at autopsy, ranging from slight to moderate. No cases of acute marked enteritis were observed. One case whose intestine showed the greatest degree of inflammation grossly also had a moderate hyperemia of the intestinal mucosa microscopically. In another case showing grossly the greatest degree of inflammation of the colon, histologic examination revealed hyperemia of the mucosa and moderate granulocytic infiltration of the lamina propria immediately beneath the surface epithelium.

Toxicity

Lamson *et al.*[3] treated 1,500 human cases of ascariasis, orally, without any symptoms of consequence. Observations made in this study showed no cases of marked toxicity, with two exceptions. Four pregnant bitches were treated with a 0.5% suspension and two of these animals exhibited nausea, vomition, and a profuse diarrhea for three to four days before recovery. The remaining two pregnant bitches exhibited no untoward symptoms.

Discussion

Hexylresorcinol suspension in either a 0.2%, 0.4% or 0.5% dilution gave variable, but generally effective, results in the removal of hookworms and roundworms from dogs, provided the proper technic was employed. It was found to be less effective in the removal of whipworms from dogs. However, a majority of the whipworm infections were light, and it was observed that greater apparent effectiveness was obtained in those cases where heavier infections were encountered. In this instance, the number of parasites in the cecum and colon were heavier and, logically, a greater relative number were destroyed. Since a number of cases examined at autopsy proved to harbor heavy infections of tapeworms throughout the length of the intestine, it was concluded that hexylresorcinol exerts no effect of consequence on this parasite. Animals harboring tapeworms exhibited, generally, the poorer results regarding treatment of the parasites under study. This was thought to be due mainly to mechanical blockage by the tapeworm which prevented the drug's contact with other parasites present. Reference is made to the apparent low total percentage effectiveness as recorded in table I, sections A and B, where a 0.5% dilution was used. In one litter of seven puppies included in this group, massive numbers of tapeworms were demonstrated at necropsy. Treatment for hookworms and roundworms was unsatisfactory in all seven cases. It is possible that better results would have been obtained in these animals had not the large number of tapeworms been present. A few animals treated in other dilutions were affected in a similar manner.

TABLE II. A Comparison of Results of Treatment as Determined by Necropsy Worm Counts and Egg-per-gram Counts

Infection	No. Exam.	Satisfactory Results	% Effective
A. Data on Cases Processed at Autopsy:*			
Hookworm	52	32	60
Roundworm	17	15	88
Whipworm	15	6	40
B. Data on Cases Processed by Egg-per-gram Counts.**			
Hookworm	13	13	100
Roundworm	12	4	33
Whipworm	3	3	100

*Presence of no more than five worms considered effective.

**Egg-per-gram count of five or less considered effective.

From this study, there appears to be some justification for the use of hexylresorcinol per enema as a drug of choice in certain instances, *i.e.* (a) debilitated, heavily infected puppies; (b) dogs primarily ill from other causes, where it is considered a practical necessity to eliminate concomitant parasitic infection; or (c) cases where a drug of low toxicity is desired.

Summary

A study of the effectiveness of hexylresorcinol suspension administered per rectum in the removal of hookworms, roundworms, and and whipworms from dogs is presented. A practical procedure for administering the anthelmintic is described. Variable, but generally effective, results were obtained in the removal

(Continued on page 122)

Results With The Clinical Use Of Kaopectate With Neomycin In Bacterial Gastroenteritis

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NEOMYCIN was reported by Waksman and Lechevalier in 1949 as being derived from the culture of a soil organism closely related to *Streptomyces fradiae.* This first report emphasized its effectiveness against organisms which had become resistant to streptomycin. However, its clinical possibilities were strengthened by its activity against a wide variety of both Gram-positive and Gram-negative bacteria[1,2].

Early investigational work showed neomycin to be particularly effective in treating surface infections due to Pseudomonas and Proteus organisms. Subsequently, it has been found to possess a wider antibacterial spectrum than bacitracin, streptomycin, or penicillin. Organisms rarely develop resistance to neomycin. It does not possess antifungal properties.

The fate and distribution of ingested neomycin was investigated by Poth *et al*[3]. Approximately 3% of the ingested antibiotic was excreted in the urine. The major portion was passed in the feces unaltered.

Kaolin and pectin separately, or in combination, have been used for a number of years for the treatment of gastroenteritis. Kaolin acts as an absorbent for toxic material and bacteria present in the bowels and also as a protectant to the intestinal mucosa. Pectin has been employed with kaolin in solution primarily as a suspending agent, but has been reported to have the ability to absorb toxins and bacteria. It also has been found to be soothing and protective to inflammed intestinal tract[4].

In light of the foregoing information, it was logical to assume that a combination of kaolin, pectin, and neomycin in a liquid form would be highly effective in the treatment of bacterial gastroenteritis. A product of this nature was made available for clinical trial in May 1952.

Procedure

An attempt was made to limit the use of this product to the treatment of bacterial gastroenteritis. Cases were selected on the basis of a clinical diagnosis, with parasitic enteritis, enteritis associated with virus diseases, and enteritis of mechanical origin excluded. Bacteriological identification and quantitative counts were done on a portion of the cases but it was difficult to determine if the kind and number of bacteria present was the cause of the gastrointestinal disturbance.

Dosage

The optimum daily oral dosage level of neomycin sulfate for both man and dog was found to be 0.1 gm. per kg. of body weight divided into six portions and administered on a four-hour schedule (Poth *et al.,* 1950). Kaopectate with neomycin contains 0.25 gm. of neomycin sulfate per fluid ounce. One ounce of the suspension per 5 lb. body weight per day, administered orally, on a four-hour schedule was used in this study.

Quantitative Bacterial Counts

Bacteriological studies were made on six cases to determine the total Gram-negative and Gram-positive counts before, during, and after the above therapeutic schedule. There was not a single instance of failure to reduce the entire bacterial flora to extremely low numbers within 24 hours.

Bacterial Identification

Twelve cases of enteritis, in which the bacteria involved were identified, were treated with kaopectate with neomycin. These were chronic cases which, in most instances, had been treated previously by other means with undesirable results. A digest of these cases appears in table 1.

Eleven responded rapidly to therapy. One, which was found to have a chronic catarrhal enteritis on necropsy, failed to respond.

Most types of bacteria found were normal inhabitants of the intestinal tract, as can be seen from table 1. While it is unfortunate that repeat samples were not taken in all instances following treatment, we assumed that, in view

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Kaopectate with neomycin used in these studies was supplied by The Upjohn Co., Kalamazoo, Mich.

of the previous treatment and the rapidity of response, the bacteria were pathogenic in these cases.

Clinical Application

Fifty-six dogs were treated as outpatients for gastroenteritis thought to be due to bacteria. The dosage schedule was followed as closely as practicable. These animals had been exhibiting symptoms from two days to three weeks prior to presentation for treatment. Telephone contact was made with owners to evaluate treatment. The results were uniformly consistent, with stools returning to normal in 24 to 96 hours. Recurrence of the diarrhea was noted in two cases. One of these subsequently proved to be a case of histoplasmosis. Dogs tolerate the administration of the mixture well, and in no cases were toxic reactions manifested. The limited degree of absorption of the neomycin precludes the likelihood of severe toxicity.

Discussion

Kaopectate with neomycin has met with our best expectations in the treatment of bacterial gastroenteritis in dogs. During the period of trial the compound has become an essential addition to our pharmacy. It has given consistently better clinical results than products heretofore available. The broad antibiotic spectrum of neomycin and its incorporation into a base which has proved desirable antibacterial and protective properties makes an ideal combination.

Summary

1. Clinical treatment of bacterial gastroenteritis with kaopectate with neomycin has been studied.

2. Dosage was established as one fluid ounce of the compound per 5 lb. of body weight per

(Continued on page 122)

Table I.

Case No.	Bacteria Involved	Duration of Illness	Previous Treatment	Results Neomycin	Follow-up
1	*Sal. bredeney*	Intermittent 9 mo.	Kaopectate	Feces normal 3rd day	2 wk.
2	*E. coli* *P. vulgaris* Paracolon	2 wk.	No treatment	Feces normal 3rd day	——
3	*Sal. cubana*	2 wk.	Kaopectate Sulfathalidine	Feces normal 4th day	3 wk.—neg.
4	*E. coli* *P. vulgaris*	4 wk.	Kaolin-Sulfa	Feces normal 6 days	——
5	E. coli	2 wk.	None	Feces normal 2nd day	——
6	*Ps. aeruginosa* *E. coli* *A. fecalis*	1 mo.	Kaopectate Milk of bismuth	Feces normal 5th day	——
7	*P. morgani*	1 yr.	Numerous	Feces normal 3 days Relapsed — 5 days (underdosed) Feces normal, remained so 3 days after proper dosage	——
8	*Ps. aeruginosa*	Intermittent 1 yr.	Numerous	Feces normal — 4 days	——
9	*P. vulgaris* *E. coli* *Ps. aeruginosa*	2 yr.	Numerous	No response Chronic catarrhal enteritis on necropsy	——
10	*P. morgani*	3 mo.	Sulfon. Kaolin Bismuth Pryn.	Feces normal — 4 days	——
11	Enterococcus	3 wk.	Not known	Feces normal — 3 days	——
12	*P. mirabilis* Paracolon	3 wk.	Not known	Feces normal — 2 days	——

A.A.H.A. Meeting Call

Dr. Louis A. Corwin, president of the American Animal Hospital Association, has announced that preliminary plans have been completed for the forthcoming annual meeting of the A.A.H.A., to be held at Hotel Statler, New York, May 5-8, 1954. Dr. Clarence P. Zepp, Sr., and his Program Committee, have arranged for a three-day program, starting on Thursday, May 6, and continuing until the afternoon of May 8. The program will feature

Dr. Louis A. Corwin

subjects pertaining to the practical side of hospital management, as well as an attractive, assorted group of scientific papers on the various phases of surgery, orthopedics and internal medicine. Closed circuit television for demonstration of surgical and laboratory technics will feature this meeting. The Pitman-Moore Laboratories and the Radio Corporation of America will sponsor the television program.

The Local Arrangements Committee is making a special effort to provide guests of the convention with an opportunity to enjoy the many attractions New York has to offer, such as tours of the United Nations Building and Radio City, visits to ball games, museum trips and boat rides around the island.

Programs and cards for making hotel reservations are available from Dr. Wayne H. Riser, executive secretary, American Animal Hospital Association, 5335 Touhy Avenue, Skokie, Illinois.

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Dr. Paul M. Newberne, A.P.I. '50, has joined the faculty of the School of Veterinary Medicine, University of Missouri, Columbia.

Hexylresorcinol for Removal of Worms

(Continued from page 119)

of hookworms and roundworms using dilutions of 0.2, 0.4 and 0.5% hexylresorcinol. The drug was appreciably less effective in the removal of whipworms. An apparent low toxicity and a lack of significant damage to the intestinal mucosa were observed. Further studies regarding practical application are indicated.

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Kaopectate and Neomycin in Gastroenteritis

(Continued from page 121)

day divided into six doses and administered on a four-hour schedule.

3. Quantitative bacterial counts were made in six cases.

4. Identification of causative organisms was made in 12 cases.

5. Fifty-six additional outpatient dogs were treated with excellent results.

6. No toxic effects of the compound were observed.

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EDITORIAL COMMENTS

New Appointees in Agriculture Research Service

According to recent administration memorandum of the USDA, Agricultural Research Service, signed by Dr. B. T. Shaw, administrator, Dr. Morton R. Clarkson is named deputy administrator of regulatory programs for both crops and livestock. A directorship has been set up in the organization chart under the deputy administrator for livestock regulatory programs. No assignment has been announced to fill the position. Chief of branch positions have been filled by division officers of the now defunct Bureau of Animal Industry. Dr. Robert J. Anderson, formerly assistant chief, BAI is appointed chief, animal disease eradication branch, Dr. C. L. Gooding, formerly in charge, inspection and quarantine division as chief, animal quarantine branch; and Dr. A. R. Miller, formerly in charge, meat inspection division as chief, meat inspection branch.

Appointment of the deputy administrator for research is not yet announced. Mr. O. E. Reed, formerly of the dairy research division of the Department of Agriculture is named as director, livestock research,

Branches of the livestock research directorate are: Animal disease and parasite research, dairy husbandry research, and animal and poultry research, Chiefs of these branches named are Dr. B. T. Simms, formerly chief, BAI, Ralph E. Hodgson, and T. C. Byerly, respectively.

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"The New Veterinarian"

Writing in *Coronet* (November 1953), Lawrence Lader reviews some of the revolutionary changes in veterinary practice of the past half century. He compared operation of the practice Dr. C. A. Mohr, KCV '11, 40 years ago, to the facilities of his son, Dr. C. A. Mohr, Jr., Tex. '42 for serving the livestock of clients in his practice area in Oklahoma as symbolic of amazing advancement. Doctor Mohr, Jr. makes calls in his well equipped Consolidated Vultee Stinson plane.

Providing health service to the nation's food and pet animals has kept pace, even surpassed in some instances, medical care of the population. The development is a logical one and was stimulated by necessity . . . the necessity of reducing losses due to disease, not only to assure growers of profits for livestock production, but adequate meat food for a rapidly growing population. That stimulus continues to challenge veterinarians who are seeking new procedures, better and more dependable methods, and improved specifics for disease control. Today's practitioner, like his forebearers, thinks in terms of facts proved by research. These he applies to his practice operation, which means that 20th century cattlemen, dairymen, swine and sheep growers, as well as breeders and owners of pets, receive better health service for their animals than ever before.

This improved veterinary service is more costly than formerly. Results justify the increased cost. Well-informed stockmen demand the improved care made possible by more thorough training of veterinarians and advances in useful equipment employed in practice. Whether it be a two-way radio communication system, facilitating prompt service and conserving the practitioner's time, or an *x*-ray machine to visualize pathology, or many other pieces of adaptable equipment, experience has shown these to be good for the livestock industry.

Now, even as at the beginning of civilization, man is dependent on his herds and flocks for food and clothing. The vital importance of the health of these animals is no less than the fact that the future strength of the nation rests upon it.

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Both sun-cured and dehydrated hays lose carotene in storage at a rate markedly affected by temperature. During winter, with temperatures below 40 F., rate of loss is negligible, but in summer rate of loss increases, and in hot weather (90 to 100 F.) all may be lost within a few weeks—*Nutrition News Bul.*

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Writing in *Hoard's Dairyman* for January 25, 1954, Dr. George H. Hopson cites instances that tend to substantiate the fact that udder disorders in dairy cows are man-made. He asserts that, "If you want to maintain healthy udders and control mastitis, your milking machine must be in perfect mechanical operating condition. Furthermore, it must be properly used."

Lesions of Bluetongue in Sheep

The sheep whose hoof is illustrated above, was identified as being infected with bluetongue in September 1953. This animal was slaughtered in January, 1954. It will be noted that damage done in the coronary hand resulted in improper growth of the horny structure. This is regarded as a valuable photograph as such a condition in sheep would, in all probability, indicate that it had recovered from bluetongue infection. There are, of course, other conditions which might occasionally cause similar hoof structure changes, and also bluetongue infection may not always do so.

Photo courtesy Dr. J. E. Stuart, Chief, California Division of Animal Industry, Sacramento.

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Vitamin D and Milk Fever

Using a group of cows having histories of milk fever attacks, work at Ohio indicates that vitamin D feeding at high levels for a brief period prior to calving serves to prevent milk fever. Further experimental work is planned under practical herd conditions. Practicability of this prevention method hinges on results of further investigation.

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Proceeds from the 1954 Buddy Poppy Campaign, as in previous years, will go to help needy and disabled veterans.

Illinois Rabies Control Law

Provisions of the new Illinois Rabies Control Act do not take cognizance of proved results of compulsory vaccination for the control of rabies in dogs. Veterinarians in Illinois will cooperate to the fullest extent for eradication, but will encounter difficulties due to the administrative methods set out by law.

The new Act does not provide for compulsory vaccination as some news reports may lead the public to believe. It states in part, "Prior to June 1 of 1954 and of each year thereafter, or at such intervals as may hereafter be promulgated by the Department, every owner of a dog not confined at all times to an enclosed area, or on a leash, or muzzled when at liberty, shall cause such dogs to be inoculated against rabies by the Rabies Inspector, or by his deputy, or by any licensed veterinarian." It requires that the Board of Supervisors of each county shall appoint, annually, a licensed veterinarian as Rabies Inspector, and also provides that deputy inspectors be appointed to aid him.

No less than the best known methods of disease control can be expected to be successful. The Illinois law compromises with infection and thereby violates an elementary principle of disease control.

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Symptoms of vitamin A deficiency in cattle, now reported from widely seperated regions of the United States and attributed to last season's drought, are unthrifty appearance, rough dry skin, night blindness, eye changes with exudation, and lachrymation. Muscular incoordination may be observed in later stages. Pregnant animals either abort or produce blind, weak, or dead calves. Retained placenta is also a common symptom of vitamin A deficiency.

Calves are born with small body stores of vitamin A even though dams have been provided vitamin-rich rations. Colostrum, rich in vitamin A, is all-important for survival during early life. —*Nutrition News Bul.*

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Poliomyelitis, as a mild infection primarily, is a prevalent disease. A great percentage, estimated to be as high as 98%, of the adult population of the United States carries antibody titer against one or more types of the virus agent of this disease. This does not mean that this group has safe protection against the three known types of virus.

"No Milk Fever in This Herd"

Under the above caption, a feature article in *Hoard's Dairyman* for January 10, 1954, it is suggested that the incidence of milk fever might be the responsibility of the nutritionist.

This article by Raymond Coppock refers to field research in one Jersey herd being conducted by Dr. J. M. Doda and Dr. H. H. Cole of the University of California. The herd that served for investigation is reported to have suffered significant losses due to postpartum paresis. Incidence averaged between 35 and 40%.

The possibility that low blood calcium levels, observed as symptom of milk fever, resulted from failure of parathyroid activity, stimulated these researchers to divide the herd for a feeding experiment. Cows most likely to develop symptoms were divided into four groups and were fed special rations that contained various levels of calcium and phosphorus. Group 1 (14 cows) received alfalfa hay alone, having a Ca-P ration of 6:1. Of this group five developed symptoms of milk fever after calving. Group 2 (19 cows) was fed a mineral-supplemented ration having approximately the same Ca-P ratio. Milk fever occurred in five of this group. Group 3 (20 cows) received a Ca-P balance of 1:1. Three of this group developed symptoms. Group 4 (16 cows) received a ration having a Ca-P ratio of 1:3.3. None of this group developed symptoms of milk fever. In summary the writer quotes these investigators as stating that, "The results of this experiment indicate that a low-calcium, high-phosphorus ration fed for approximately one month before parturition will prevent milk fever in dairy cattle".

It was pointed out editorially, in this publication, that these early returns must be substantiated before being applied. Nevertheless, results appear to be indicative that stimulating activity of the parathyroid gland briefly, prior to calving, by supplying high phosphorus diets, may influence favorably incidence of milk fever in those herds where difficulty is being experienced with this metabolic disturbance.

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Summary prepared by the Foreign Agricultural Service, reveals that 1953 was the sixth consecutive year in which world agricultural production was above the immediate prewar years. It concludes that the world's increasing population is eating about as well today as it did immediately prior to World War II.

Test Hog Cholera Vaccines

Progress reports on tests of hog cholera vaccine as marketed by a number of manufacturers is contained in a recent release from the University of Illinois.

Pigs used in these tests were eight to ten weeks of age, weighing 40 to 45 lb. All had been raised on synthetic milk. Groups of various numbers were vaccinated according to manufacturers' directions and susceptible controls allowed contact during the 30-day experiment. Test pigs were exposed by challenge with 5 cc. of virulent hog cholera virus at 4, 8, 10, 12, and 30 days postvaccination. All pigs vaccinated with one of four different vaccines survived challenge. All controls succumbed.

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Profession and Business

A gentleman, wishing to provide his son with money to start a business, wrote his will accordingly, reports the *British Medical Journal* (April 18, 1953). The son later qualified as a physician, and applied to the trustees of the estate for the money to begin practice. The trustees, undecided whether the practice of medicine was a business, sought the answer from a magistrate who answered, that in his judgment, the term "business" should not be narrowly construed. The object of the will was plainly to aid the son, and the magistrate stated that the word business seemed capable of including a profession and plainly included the medical profession. Decision to grant the money was made accordingly.

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Soyin, a Toxic Protein in Raw Soybeans

Feeding tests by Liener and Pallansch of the University of Minnesota indicate that about 50% of the growth-inhibiting effect of raw soybeans is due to the presence of soyin, a recently discovered protein isolated in sufficient quantities for rat feeding tests. This protein loses its toxic properties on heating.—*Nutrition Reviews.*

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A survey conducted by the American Can Company estimated that more than 1,500,000-000 cans of pet food—double the production five years ago—were used in feeding the nation's pets in 1953. American families kept 22,600,000 dogs and 26,700,000 cats.

VETERINARY PARASITOLOGY

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Dieldrin for Sheep Scab

A report from South Africa[1] states that a single dipping in 0.03% dieldrin is an effective and safe treatment for psoroptic sheep scab. The tests were limited, but results were interpreted as superior to those obtained with BHC. Aldrin was not reliable in concentrations of 0.05%, and higher concentrations of either chemical are contraindicated because of the risk of poisoning.

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Experimental Cerebrospinal Filariasis

Japanese workers at the Ministry of Agriculture and Forestry, Tokyo, have succeeded in producing experimentally in goats the paralytic disease that has become variously known as lumbar paralysis, epizootic cerebrospinal nematodiasis (or filariasis or setariasis) and neurofilariosis[2]. Readers of this page will recall earlier notes on the condition (47:38 and 434, 1952).

The latest experiments were ingenious and direct. Mosquitoes (*Armigeres obturbans*) were collected as larvae and reared to adult stage. About 24 hours after emergence, the mosquitoes were allowed to feed on an ox that showed microfilariae of *Setaria cervi* in its blood. For 13 to 15 days thereafter, they were kept in an insectarium and artificially fed. They were then dissected and the infective larvae were isolated from the proboscis and salivary glands. The larvae, in saline solution, were injected subcutaneously into nine goats. Ten goats of the same herd served as controls. All the goats were kept in the same screened quarters and fed the same diet. After 14 to 38 days, seven of the nine injected goats developed motor weakness and incoordination which, in some, proceeded to complete paralysis. In six of these animals, the whole pathological complex of traumatic encephalomyelomalacia was demonstrated. None of the control animals exhibited any clinical signs that were referable to the central nervous system.

These findings are convincing evidence that the infective, mosquito-stages of Setaria from the bovine host can produce the disease in goats following introduction subcutaneously.

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Fertility of Rats Affected by Sulfaguanidine

In recent experiments,[4] the litter size of rats was reduced by feeding sulfaguanidine for 30 days before mating and, when the chemical was fed for four generations to pregnant and lactating rats, the number of offspring was reduced 95%. There was a decrease in activity and food intake, and hyperplasia of the thyroid was a constant finding in rats that were fed large amounts of the chemical. Although the effect did not continue beyond one generation when the drug was discontinued, the conclusion was reached that continuous feeding of sulfaguanidine could result in sterilization of the colony.

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Inexpensive, low-pressure (60 lb.) sprays, applying about 1 gal. per sheep, gave good control of keds in trials conducted by the U. S. Bureau of Entomology, and Plant Quarantine[5]. DDT, chlordane, toxaphene, and methoxychlor at a concentration of 0.5% and gamma BHC at 0.025% were effective. The addition of about 0.1% of a commercial wetting agent[6] proved desirable for best killing action.

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According to a brief report by Dr. S. C. Eitreim, Crawford, Nebraska (*Rocky Mountain Veterinarian*, Dec. 1953), farmers and ranchers in his area have been reporting an unusual number of skunks, and other wild animals, found dead on their premises. A squirrel, which was later proved rabid, bit a resident of Crawford. Veterinarians of the region are concerned that rabies may be the cause of the unusually large number of deaths observed among wild life.

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[6] Vel or Tide.

POULTRY PRACTICE PROBLEMS

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Professor Leo F. Rettger
1874 - 1954

I am dedicating this month's contribution to a pioneer in poultry disease research, Dr. Leo F. Rettger. He is best known to the veterinary profession and to the poultry industry for his discovery of the cause of pullorum disease in 1899, and for his life-long interest and research on this disease. Until the time of his death, in New Haven, Connecticutt, on January 7, 1954 a the age of 79 years, he was constantly a champion for eradication of pullorum disease and lived to see his aim all but accomplished.

Doctor Rettger was born in Huntington, Indiana on March 17, 1874. He graduated with an A.B. degree from the University of Indiana in 1896, and a year later obtained an M.S. degree from the same university. In 1902, he received his Ph. D. degree in bacteriology from Yale University. From 1902 until his retirement in 1942, he was a member of the staff of Yale University Department of Bacteriology, and from 1919 to 1942 was professor of bacteriology. On retirement, he was made emeritus professor. From 1909 to 1946, Doctor Rettger was also nonresident bacteriologist in charge of investigations of animal diseases at the Storrs Agricultural Experiment Station.

Although he was not a veterinarian, Doctor Rettger stands high along with a large number of other medical scientists who have made major contributions to the field of veterinary medicine. A large proportion of his graduate students at Yale did their research on problems directly related to veterinary science, and many of these are continuing in this field. As bacteriologist in charge of animal disease research at Storrs, he along with such colleagues including Dr. W. N. Plastridge, and Dr. E. L. Jungherr was responsible, for outstanding research in cattle and poultry diseases.

Doctor Rettger has received many honors for his accomplishments in the field of bacteriology, but one that he cherished especially was his election as an honorary member of the American Veterinary Medical Association in 1941. Another honor bestowed upon him, for his interest in animal disease research, was election as president of the North American Conference of Research Workers in Animal Diseases in 1933. He also was active in the United States Livestock Sanitary Association, and was a charter member of the Northeastern Conference of Laboratory Workers in Pullorum Disease Control. In 1917, he served as president of the Society of American Bacteriologists.

These are only a few of Doctor Rettger's accomplishmens and honors which will be enumerated fully by other biographers. Finally, I want to state again that both the veterinary profession and the poultry industry owe much to him. As one of his many graduate students, I am especially indebted for the training, advice and guidance he gave me. I owe what professional success I enjoy to a large number of people, but I always have placed Doctor Rettger, along with the late Dr. L. D. Bushnell, formerly professor of bacteriology, Kansas State College, at the top of the list.

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Carter and Byrne (*Cornell Vet.*, 43:223, 1953), in serological study of 68 strains of *Pasteurella multocida*, by two precipitation technics and a capsular swelling test (Carter, *Can. Jour. Med. Sci.*, 30:48, 1952), separated them into four types designated by A, B, C, and D. Types A, B, and C predominated in strains from cattle, swine, and buffalo. A total of 14 avian strains were typed. Five of these were type A, four type B, one type C, three type D, and one undesignated. Proposed alphabetical designations have been compared to their equivalent in previous groupings by Rosenbusch and Merchant (*Jour. Bact.*, 37:69, 1939), Little and Lyon (*Am. Jour. Vet. Res.*, 4:110, 1943) and Roberts (*Jour. Comp. Path. and Ther.*, 57:261, 1947).

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Trinidad Island has been added to the ever increasing list of areas where Newcastle disease is present in poultry flocks (Schofield and Hutson in *Can. Jour. Comp. Med.*, 16:415, 1952). These authors describe what is believed to be the first outbreak of the disease in the British Caribbean area. The source of the virus was not determined but it is suggested that it may have been introduced by importations of frozen poultry.

ABSTRACTS OF LITERATURE

Anesthesia for Birds

Cheng-Chun Lee has recently evaluated action of several anesthetics used in poultry surgery[37]. Ether and chloroform were found inadequate for use in all species tested, often causing sudden death. Chloral hydrate orally was found safest of anesthetics tested. Sodium amytol intravenously was effective in geese and ducks; pentothal sodium by the same route, unsafe and of short duration. None of the five anesthetics appeared safe for use on pigeons.

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Fattening and Sterilization of Swine with High Dosages of Estrogenic Substances

After a single subcutaneous dose of estrogenic substances, *e.g.*, diethylstilbestrol diacetate, using 10 mg. per kg. body weight,[38] the weight of pigs (females or castrated males) increased daily 1.20 to 1.40 kg. if they were fed a carbohydrate-rich ration. If a protein-rich diet was fed, the hormone treatment yielded only 0.73 to 0.85 kg. weight gain daily.

Castration of boars of 200 to 250 kg. body weight was successful in three of four cases; the dosage was 10 mg. per kg. body weight, repeated in one week if the male did not calm down after the first injection.

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Vitamin D as an Aid in Preventing Postpartum Paresis

Prompt treatment of milk fever in dairy cows has lowered mortality from this disease from 60 to 70% to less than 1%. However, due to hazards connected with an attack, it is desirable that a simple prevention method be evolved.

Ohio researchers report that the feeding of massive doses of Vitamin D[3] prior to freshening will prevent milk fever. The simple procedure calls for feeding 30,000,000 units of vitamin D daily for five to seven days before calving. The form of vitamin D used in research work was either oil concentrated irradiated ergosterol or type 142-F irradiated dry yeast. This level of vitamin D intake is approximately 6,000 times higher than the recommended daily allowance for lactating cows.

No harmful effects have been demonstrated or are likely to occur from feeding large doses of vitamin D during the short time needed for the prevention of milk fever. Prolonged feeding at these levels was shown to be harmful. Work is continuing to determine the practicability of this suggestion for prophylaxis.

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Blue Comb in Chickens

Blue comb is a pathological complex resembling shock in the early phase, with enteritis apparent in less acute cases. Accumulated data from field outbreaks in Florida indicate that climatic stress might be a contributing factor in the incidence of this disease of poultry. A maximum temperature exceeding 85 F. was found to occur three or four days[4] before cases were presented to the laboratory for diagnosis. By this time, enough losses had occurred to be brought to the attention of flock owners.

Diagnostic laboratories in New England also have made observations on the influence of weather on the incidence of this poultry disease. Five laboratories received, during a two-day period in 1951, more than 71 cases after temperatures of 78F. or over were recorded. A prediction made in 1952 confirmed earlier results of studies. Highest incidence occurred during the hot months of summer.

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Writing in *Hoard's Dairyman* for January 25, 1954, Dr. George H. Hopson cites instances that tend to substantiate the fact that udder disorders in dairy cows are man-made. He asserts that, "If you want to maintain healthy udders and control mastitis, your milking machine must be in perfect mechanical operating condition. Furthermore, it must be properly used."

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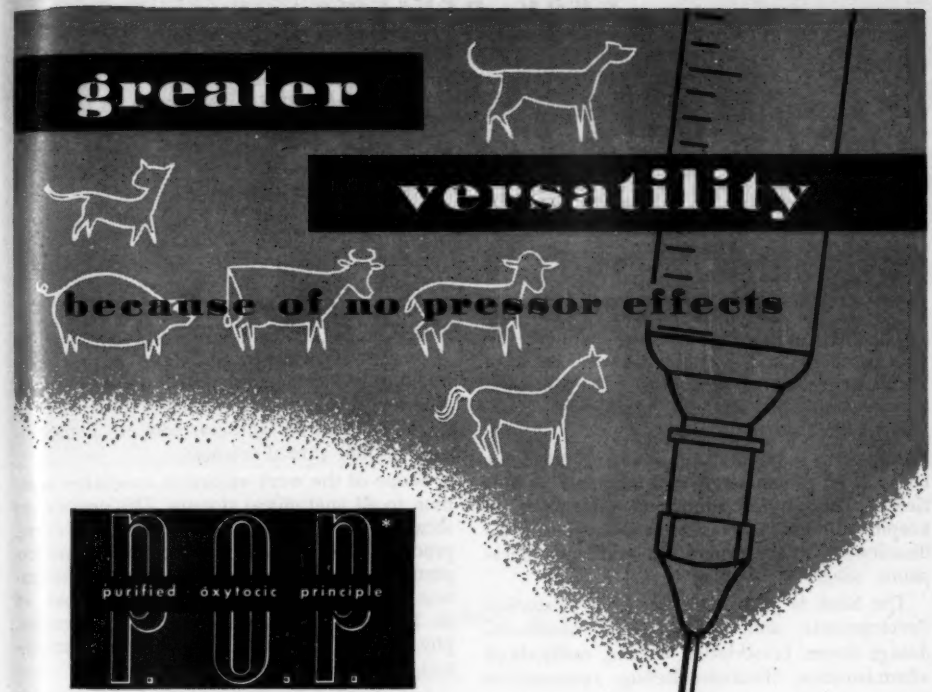
[37]Cheng-Chun, L., Experimental Studies on the Actions of Several Anesthetics in Domestic Fowls. *Poultry Sci.*, 32:624 (July), 1953.

[38]Bajez, Edgar, Mast-und Sterilisationsversuche bie Schweinen mit hohen Dosen ostrogener Wirkstoffe. *Wien, tierarztl. Monatsschr.*, 40:226 (April), 1953.—*R. S.*

[3]Hibbs, J. W., and Pounden, W. D., *Ohio Farm and Home Research*, Nov.-Dec., 1953. pp. 108-9.

[4]Van Ness, Glenn, Weather. Influence in Blue Comb in Chickens. *Science*, 118:601,, 1953.



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BOOK REVIEWS

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VETERINARY PHARMACOLOGY AND THERAPEUTICS by *L. Meyer Jones*, A.B., D.V.M., Ph.D., Professor of Pharmacology, Iowa State College, Ames. 850 pages. The Iowa State College Press, publishers, Ames, Iowa, 1954.—Price $11.

This thoroughly up-to-date textbook on pharmacology and therapeutics will be most useful to the entire profession. Doctor Jones has prepared an outstanding work, well organized for study or as a reference.

Appearance of this book also is welcome because of phenomenal developments in this field. The author admits to difficulties in keeping abreast of advances in new drugs, combinations that are synergetic, and new therapeutic usage.

The book is prefaced (Part I) by historical developments, sources of drugs, standards, dosage forms, prescription writing, methods of administration, factors altering response to drugs, and general pharmacologic principles of drug activity. Thereafter, text material is arranged so that drugs affecting predominantly one physiological system of the body are discussed with respect to pharmacognosy, pharmacodynamics, therapeutics, and toxicology. This organization of subject matter has been selected primarily because of its usefulness, as proved by experience, in the author's teaching program, As an example; Part IV considers drugs acting on the central nervous system. Discussions appear under chapter headings, of which there are five in this part. These deal with inhalant anesthetics; intravenous anesthetics; hypnotics, sedatives, analgesics, and anticonvulsants; and stimulants. Other parts have fewer or more chapters as indicated.

Typography of the text is superior. Chapter, subheadings, and sideheadings are clear. Type selection is pleasing and printing skillfully done on fine enamel-finished book stock. Reference list appends each chapter and a comprehensive and carefully prepared index completes this most valuable addition to veterinary literature.

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Business Practices in Veterinary Medicine by *Haas and Haas* now available—price $5.50.

CANINE MEDICINE edited by *H. Preston Hoskins*, V.M.D., *J. V. Lacroix*, D.V.S., and *Karl Mayer*, B.S., D.V.M. 650 pages, 214 illustrations. American Veterinary Publication, Inc., Publishers, Evanston, Ill., 1953.—Price $12.

The work of 40 authors has been compiled by three editors, two of whom have contributed to the text material, in Canine Medicine. Authors include well known practitioners, teachers, research workers, and other specialists in small animal diseases.

Scope of the work embraces anomalies common to all anatomical systems. Discussions are arranged by chapters devoted to each of these, preceded by chapters that consider matters pertaining to clinical examination, administration of medicines, and nutrition. Chapters 18 to 26 deal with groups of infectious diseases, physical and toxic agents, gerontology, euthanasia, and inhalation therapy.

In no other work is so much information available that is useful to students, or practitioners specializing in small animal practice. All discussions are authoritative and each is appended with a list of selected references from current literature and recently published textbooks.

As is to be expected in such a textbook, style of writing varies with different writers. This does not detract from the value of material and editors are to be congratulated for consistency of presentation. The opinion of readers will vary, also, as to length of discussions of different subjects. This may not be considered always to be in proportion to its importance to the whole. Generally, discussions are divided to consider incidence, etiology, symptoms, pathology, and treatment, and are clear and brief.

The book should be within easy reach as a reference to every practitioner who handles dogs. It most certainly will be employed as a basic text for advanced veterinary students.

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The U. S. Department of Agriculture has announced the publication of a revised and reprinted edition of Farmers Bulletin 1652, Diseases and Parasites of Poultry. Copies are available from the Office of Information, USDA, Washington 25, D. C.